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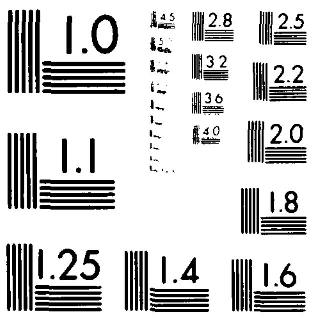

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DAVIDSON LABORATORY

Technical Report 2239
March 1982

A MODEL STUDY OF COUPLED AMPHIBIOUS VEHICLE TRAINS IN CALM WATER AND WAVES

by
G. Fridsma and W.E. Klosinski

STEVENS INSTITUTE OF TECHNOLOGY

CASTLE POINT STATION
HOBOKEN, NEW JERSEY 07030

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A model investigation of the performance of trains of up to four amphibians in calm water and waves. Measurements include the inter-vehicle towing force and the unequal division of drag among vehicles in the train is demonstrated, necessitating rigid couplings between vehicles. The optimum vehicle spacing and attitude is determined. Significant improvements in speed made good are obtained, for a given amount of installed power per vehicle, by increasing the number of vehicles in the train. The value of

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deploying bow flaps in vehicle trains is shown. Data for both 14 ton and 26 ton vehicles at speeds up to 25 mph is included.

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Prepared for
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Approved:

P. Ward Brown, Manager
Marine Craft Development Group

INTRODUCTION

A series of investigations into the hydrodynamic and vehicle mobility characteristics of tracked amphibious vehicles is being carried out by Davidson Laboratory in support of the Marine Corps Surface Mobility Exploratory Development Plan. These investigations have been initiated under the direction of the David W. Taylor Naval Ship Research and Development Center (NSRDC) Code 112 which manages the Mobility Program. The results achieved in previous investigations are reported in References 1 to 12.

This report presents the results of a model study undertaken to find the gains that can be made in the water speed of amphibious vehicles by coupling them end-to-end to form a train of vehicles. Previous exploratory studies[13] have indicated substantial reduction in power per unit vehicle when amphibians are coupled in tandem.

In this investigation models representative of current amphibians are used to determine the effects of varying the number of vehicles in the train, the effects of vehicle coupling restraints, attitude and spacing, and the optimum coupling attitude to minimize interference from the water jets. The range of the tests covered calm water and rough water (Sea State 2) conditions and vehicle weights of 14 and 26 (short) tons. During the calm water tests the inter-vehicle towing forces were measured to provide a data base for a possible future analysis of the drag of vehicle trains. Finally the optimum configurations of 2, 3 and 4 units were tested at speeds up to 25 mph in calm water and Sea State 2.

Tests were carried out in the Tank No. 3 facility of the Davidson Laboratory, during the periods 26 October through 6 November and 17 through 21 December 1981.

MODEL

The models used in this investigation are representative of current operational amphibians. In consultation with NSRDC, Code 112 a simplified version of the LVTP-7 was chosen, referred to herein as the LVT design. The models were to be representative of both 14 ton and 26 ton vehicles, so that as far as possible the results are given in non-dimensional units (e.g., drag in lb/ton). Where this is not possible the results and discussion refer to the 26 ton vehicle; conversion factors to 14 tons are given in Table 1 together with vehicle particulars.

The model geometry is shown on Figures 1 and 2. Dimensions are given in inches since two model scales are used: a 1/9-scale for the 26 ton version and a 1/7.3-scale for the 14 ton version. In its hydrodynamic configuration the LVT has side and bottom covers over its fully retracted tracks, and the track cavities are flooded. In the first phase of low-speed testing the track cavities were not represented. Solid models to the correct exterior shape were built and counterweighted to represent the weight of water in the wheel wells. For the high-speed tests, while the results of the first phase were being analyzed, the models were modified to include the track wells and water jet cavities. Simulated wheels and tracks were added and enclosed by side and bottom covers. The ends of the track wells were left open to allow for drainage.

Four models of the LVT were built. The lead vehicle was equipped with a bow flap of the type that has been proved in full-scale trials.[10] Each model was ballasted to achieve a floating trim of 1.0 degree bow-up with a draft of 0.41 beams at 55.4% of the length from the bow.

The models were coupled together in three modes shown on Figures 3, 4 and 5, either free-to-trim, fixed relative trim, or fixed parallel trim. The coupling between the models in the free-to-trim mode was made by an aluminum channel, pin-jointed at either end. This was achieved by attaching the forward end of the coupling to a pivot box and force balance

in the forward vehicle, and by attaching the after end to a hinge on the bow of the aft vehicle. The attachment to the pivot box was adjustable to provide for variation in inter-vehicle spacing.

For tests where the attitude of each vehicle relative to the other could be varied in the fixed relative trim mode, shown on Figure 4, a rectangular aluminum frame connected to vertical plates, or "ears", coupled the models together. A second strut below the waterline served to hold the relative attitude. Provision was made for varying the attitude and spacing of the models.

For the fixed parallel trim test mode, (see Figure 5), each vehicle was fixed at the same trim relative to the horizontal. This was accomplished by mounting a long rigid aluminum beam above the models and connecting the four aluminum "ears" used in the fixed relative trim mode. Adjustments relative to this frame, through predrilled holes, fixed the absolute trim of each vehicle. This configuration tends to minimize the interference from the water jet exhaust from the forward vehicle on the following vehicle.

APPARATUS AND INSTRUMENTATION

The tests were carried out in the Davidson Laboratory Tank No. 3 using a standard free-to-heave apparatus, which was coupled to the lead vehicle through a pitch pivot box and drag balance. The pitch axis on the lead vehicle was located 18.93 inches (55.35 percent LOA) aft of the bow and 5.17 inches (.366 beams) above the hull bottom. In all tests, the lead vehicle in the train was free-to-pitch and heave but restrained in yaw, roll and sway. Transducers measured the trim or pitch motion, the vertical displacement (heave) of the pitch axis of the lead LVT, and the total drag acting on the train of LVT's. A yaw restraint on the stern of the last LVT in the long train maintained the zero yaw configuration, but did not hinder either longitudinal or vertical motion.

The train of model LVT's, which number from 1 to 4 units, were coupled either in the free-to-pitch or the fixed pitch mode. In the calm water free-to-pitch mode tests, a force balance and a pivot box, mounted in the stern of the model, measured the relative angular position of the coupling link and the component of force in the link acting parallel to the forward vehicle baseline. In the rough water free-to-trim tests, no link forces were measured, however accelerations at the driver's station were measured on each unit in the train. These were located 6.78 model inches aft of the bow (19.82 percent LOA).

The signals from the transducers were relayed by overhead cables to the data station on shore, where they were filtered (40 Hz low pass) and processed by an on-line PDP-8e computer, which includes an analog-to-digital converter. In rough water the time histories were recorded on analog magnetic tape prior to data processing. All runs were monitored on a direct writing oscillograph.

Photography

A camera carriage ahead of and to port of the lead vehicle carried a television camera. The model behavior was observed on a monitor and a color video tape recording was made of each run. Above water still pictures were taken of selected runs in both calm water and waves.

Wavemaker

The Tank No. 3 plunger type wavemaker, located at the far end of the tank was used to generate irregular waves simulating a Sea State 2 (significant height = 2.2 ft.). The waves consist of a quasi-random reproducible set of 100 waves having variance density distribution approximating the Pierson Moskowitz spectra. The experimental spectra for the two different scales tested were measured by a stationary wave-wire prior to testing and are shown on Figure 7. A moving strut was mounted on the camera carriage to monitor wave encounters.

DATA REDUCTION

Calibrations of the instrumentation were made by applying known loads to the force balances, gravity multiples to the accelerometers, and known displacements to the motion and wave elevation transducers. During calibration, the outputs from the transducers were sent to the PDP-8 computer. All calibrations were linear, and straight lines were fitted to these data by the least squares techniques.

Data channels were scanned by the PDP-8e computer at the rate of 250 Hz and stored in the computer for processing. Test results were determined from the differences between transducer outputs in the running and static floating conditions. Velocities were computed from the time taken to travel through the data trap, which was 50 ft for calm water tests and 150 ft for wave tests.

Processing of the calm water data produced mean values for the coupling forces, link position, total drag, and the lead vehicle draft and trim. For the wave tests, a peak-trough analysis was performed on the pitch, heave, coupling link motions, and the LVT driver accelerations. A peak-trough analysis of each signal resulted in the mean and rms, the number of oscillations, the average of the peaks and troughs, the average of the 1/3 highest and the 1/10 highest peaks and troughs, and the extreme values of the peaks and troughs. Buffers were used to suppress small oscillations associated with noise and not the substantive time histories.

TEST PROGRAM

The test program was conducted in two phases. In Phase 1 a number of concepts were explored over the low speed range up to 14 mph.

Phase 1 calm water tests at speeds of 4, 6, 8, 10, 12 and 14 mph were run for the following conditions. The relative attitude is the angle of the lead vehicle relative to the following vehicle. Thus with a relative attitude of 2 degrees between vehicles, when the second vehicle is at zero trim the first vehicle will be 2 degrees bow up.

The following series of tests were run in calm water:

TEST NO.	COUPLING MODE	NO. OF UNITS	RELATIVE ATTITUDE deg.	SPACING % LOA
1	Free-to-trim	1,2,3 4	- -	5.6 5.6, 11.1
2	Fixed relative	4 4	0,4,6 2	11.1 5.6, 11.1
3	Fixed relative; Units 2, 3 and 4 at zero attitude	4	4,6 First Unit	11.1
4	Fixed parallel	4	2,6	11.1
5	Free-to-trim; Two trains of two units at 5.6% spacing	2+2	-	Between Trains 5.6,23.1,58.2 78.6,96.1,128.3

From the results of the calm water tests an optimum configuration of the four vehicle train was selected consisting of fixing the relative attitude at 2 degrees with a spacing of 5.6 percent of the vehicle length. This configuration was run in head and following seas corresponding to Sea State 2. The four vehicle train was also run free-to-trim in head and following seas.

The four vehicle train was run free-to-trim, that is without pitch constraint between the vehicles, in order to contribute to the understanding of vehicle trains and to permit the measurement of inter-vehicle towing forces. In a vehicle train the total resistance is not divided equally between all vehicles, as will be discussed later. Therefore if all engines are run at the same rpm some of the after vehicles will tend to surmount the leading vehicle, unless constrained by the couplings.

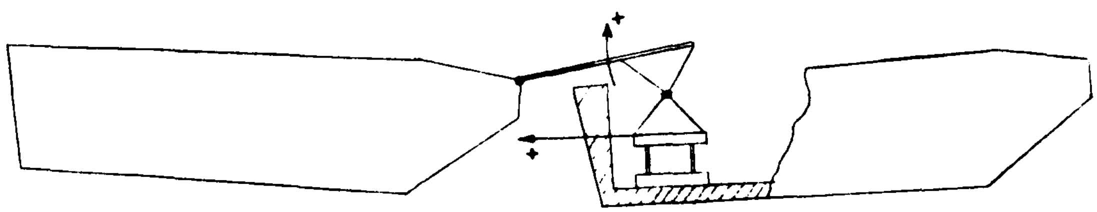
In the second phase of testing the results and observations of the first phase were used to configure the vehicle train for high speed tests. In Phase 2 each vehicle in the train was equipped with a bow flap similar to that fitted to Vehicle No. 1 in Phase 1. The bow flaps of the after vehicles were raised high enough to clear the stern of the preceding vehicles. The Phase 2 tests were run with bow flaps extended because a significant amount of water was observed to well up in the inter-vehicle spaces. For this high-speed phase of testing, wheels, track covers and drainable wheel wells were simulated.

In Phase 2 the models were ballasted to the same waterline corresponding to a vehicle weight of 26 tons. Vehicle trains with the vehicles fixed at a relative attitude of 2 degrees with a spacing of 5.6 percent LOA were assembled. Trains of 2, 3 and 4 units were run at speeds corresponding to 5, 10, 15, 20 and 25 mph in calm water and in Sea State 2 headseas.

RESULTS

The calm water results are presented in Tables 2 through 8 for the various configurations tested. Each table is labeled as to the number of units in the train, the mode of testing (whether free or fixed in trim), and the spacing between vehicles. The quantities tabulated are given in both dimensional and in non-dimensional form, as speed in mph, and speed-length ratio (knots/$ft^{\frac{1}{2}}$). The length used to non-dimensionalize the speed is the overall length of the vehicle or train, including the nominal spacing between units, but not including the lead unit's bow plate. Draft is the submergence of the hull bottom below the calm water surface at the pitch axis. It is tabulated in full scale feet and also non-dimensionalized by the beam of the craft. Both total drag and link loads, are given in pounds per short ton displacement. (A two vehicle train has a total displacement twice the displacement of a single vehicle.) The trim of the lead vehicle and the link angles in degrees are included in the Table 2.

The following schematic shows the sense of the positive link force and the positive link angle. The link angle tabulated (in the free-to-trim tests) is the angular displacement from the at-rest floating condition. The length of the link, from forward pivot to the aft hinge is equal to 11.2 percent LOA plus vehicle spacing; the distance of the pivot below the link is 2 percent LOA.



The Sea State 2 rough water results are given in Tables 9 through 16, each table dealing with either a different displacement or configuration (see the Index to Tables following Table 1). Each rough water table contains a number of sheets, one speed per sheet, bound in increasing order of speed. The test parameters are given at the head of the sheet including speed, total displacement, drag, number of wave encounters, and speed-length ratio. The remainder of the page contains the peak-trough statistics for the pitch and heave motions and the driver accelerations in each of the four vehicles (labeled A, B, C and D where A is the first unit and D the last unit of the train). For the lead unit, the heave is the vertical position of the pitch axis relative to calm water, positive up; pitch is the angular displacement of the model baseline, positive bow up. For the Phase 1 free-to-trim tests in waves, the statistics for the link motions are denoted by pitch A, B, and C (see Table 9) where pitch A is the link motions between vehicles 1 and 2, pitch B, that between vehicles 2 and 3, and pitch C, that between vehicles 3 and 4. The statistics presented are the mean and rms values, the average, average of the 1/3 highest (significant), average of the 1/10 highest, and the extreme values for the peaks and troughs.

A video tape recording of all runs has been sent to NSRDC, Code 112, together with photographs of selected runs. Table 8 contains the video tape scenario. Preceding Table 2 is an index page, which summarizes the test configurations presented in the tables.

DISCUSSION

The reduction in calm water drag as the number of vehicles in the train is increased is shown on Figure 8 for the free-to-trim configuration. The total reduction in drag/vehicle at 8 mph is summarized in the following table:

No. of Units in Train	Percent Drag Reduction at 8 mph	Increase in Speed at 116 lb/ton thrust mph
1	0	0
2	44	1.3
3	58	2.4
4	64	3.3

If sufficient thrust is available for one vehicle to achieve 8 mph, the increase in speed made good due to increasing the number of vehicles in the train is included in the above table. This third column indicates that each additional vehicle in the train increases the speed by about the same amount-1.1 mph. If the thrust is not degraded by interference between vehicles, this is a simple method of obtaining substantial speed improvements. The maneuverability and control of the long train, especially in surf, should be investigated.

Another similar comparison can be made for the 2 degree fixed relative configuration in calm water. The table below presents the percentage drag reduction (drag/ton) that can be achieved for 2, 3, and 4 vehicle trains at 5, 10 and 15 mph. It should be noted that the single vehicle is not hydrodynamically designed for speeds of 20 and 25 mph and therefore would not be operated above 15 mph.

Percent Drag Reduction

No. of Units in Train	Speed, mph 5	10	15
1	0	0	0
2	44	45	76
3	53	60	84
4	59	68	87

The effect of varying the fixed relative attitude on the drag of a four vehicle train is shown on Figure 9, and the effect of varying the spacing is shown on Figure 10. Using the expanded drag scale of these figures, there does appear to be a slight advantage in using an attitude of 2 degrees at a 5.6 percent spacing. It is more significant to note that at larger attitudes and spacings an increased amount of bow wetting was observed on all following vehicles.

The effect of the coupling configuration on the drag of the four vehicle train is shown on Figure 11; the free-to-trim mode is included for reference. It is apparent that the fixed relative mode of coupling results in less drag than either the fixed parallel or free-to-trim modes. It was on this basis that further testing was done with the 2 degree fixed trim configuration, an optimum from both the drag and deck wetness points of view.

Before discussing the rough water and Phase 2 tests, some analysis of the inter-vehicle forces in the free-to-trim mode is presented. In the free-to-trim tests the towing force in each coupling was measured, and from these measurements it is possible to determine the contribution of each vehicle to the total drag. When the calculation was carried out for the first series of tests, it was found that at 12 mph the second vehicle in the four vehicle train was generating a thrust instead of a drag. To validate this surprising result, the four vehicle train was split into two trains of two units each and tested in such a manner that spacing between the trains could be varied. In these tests vehicles 1 and 2 were attached to one towing carriage by a drag balance, and vehicles 3 and 4 to a second towing carriage by another drag balance, as shown in the lower photograph of Figure 6.

The drag measured at 12 mph on each vehicle is shown on Figure 12 as a function of the spacing between vehicles 2 and 3. This test confirmed the occurence of negative drag on the second vehicle for spacings less than 75 percent of the vehicle length.

The unequal division of drag between the four vehicles is brought out by Figure 12. Consequently, unless a rigid coupling is provided between vehicles, a means of adjusting the thrust of each vehicle to match its drag must be provided.

The four vehicle train was tested in a Sea State 2 using the 2 degree fixed relative trim configuration. Sea States and speeds were adjusted and separate model tests were run to determine the effect of vehicle displacements of 14 and 16 short tons. The effect of wave direction, head and following seas, was also investigated.

The drag data presented on Figure 13 shows the small vehicle to have the higher drag on a non-dimensional lb/ton basis, at a given speed. The added drag in waves is also greater for the small machine on this non-dimensional basis, at the same water speed.

The effect of vehicle size on the motion amplitudes and driver's acceleration is shown on Figure 14. The 14 ton LVT train experiences greater motions than does the 26 ton train, however the increases are not substantial. The effect of the load on accelerations in Sea State 2 is negligible. Tests in following seas resulted in reduced heave motions, especially at low speeds, but about the same pitch motions. Accelerations in following seas were essentially zero for both size LVT trains.

The Phase 2 investigation concentrated on the behavior of vehicle trains of 26 ton units, operating in the 2 degree fixed relative mode at the 5.6 percent spacing, in calm water and headseas at speeds up to 25 mph. The drag characteristics of 1, 2, 3 and 4 units in both calm water and headseas are shown on Figure 15. Some of the data from Phase 1 is included to demonstrate the repeatability of the data.

The drag continues to increase with speed up to 25 mph, and in the case of the 4 vehicle train is still increasing at 30 mph. Observations of this train running at high speed gave the impression of considerable side-wetting, track wells flooded, no transom ventilation between vehicles, and little transom separation at the last vehicle. Thus all the indicators of planing were absent. For the four vehicle train to reach 30 mph, each unit would have to have 6 times the thrust, or 23 times the power of a single unit capable of 8 mph. The added drag in waves reaches a maximum at 15 mph and then decreases at higher speeds.

The variation of draft and trim of the lead vehicle with speed up to 25 mph is shown on Figure 16 for 2, 3 and 4 units. It may be

noted that the leveling off of the trim track at high speed is not accompanied by a significant reduction in the rate of drag increase with speed.

The heave and pitch motions in Sea State 2 headseas are shown on Figure 17. While the heave motions are similar for 2, 3 or 4 units, they are markedly speed dependent, being greatest at 5 and 25 mph with a minimum response at 15 mph. Pitch motions on the other hand, are more affected by the number of vehicles in the train, especially at low speed, with the smaller trains experiencing the greater pitch motions. These motions decrease with speed for the 2 and 3 unit trains until speeds of 15 mph are reached, and then essentially stay constant. The 4 unit trains's significant double amplitude pitch motions remain just below 2 degrees across the entire speed range.

Accelerations shown on Figure 18 are, for all practical purposes, independent of train size and speed. The lead vehicle is subjected to the largest g loads, on the order of 0.2 g (average 1/3 highest positive values). For all other units, the acceleration magnitudes are about 0.1 g.

CONCLUDING REMARKS

This investigation of trains of amphibious vehicles confirms the findings of previous studies, that either the drag is reduced at given speed or that the speed is significantly increased at given thrust/weight ratio, by coupling vehicles together in trains of 2, 3 and 4 units.

It is shown that the drag is unevenly divided between vehicles and that therefore a rigid coupling must be used. The drag is not very sensitive to the coupled configuration, but a relative trim of 2 degrees between vehicles, with a spacing-length ratio of 0.056, was found to give minimum drag, and minimum deck wetness.

In order to take advantage of the speed potential of coupled vehicles, the lead vehicle must be equipped with a bow flap. In order to minimize deck wetness of the following vehicles in the train, it is advantageous for them to deploy their bow flaps.

The longer vehicle trains experience less pitching motion although heaving is unaffected. Accelerations at the drivers stations are practically unaffected by the length of the train.

Comparison of 14 ton and 26 ton vehicle trains leads to the conclusion that the smaller vehicles have a rougher time in Sea State 2 than do the larger vehicles. The specific powering requirements (lb/ton) and the motions are greater for the smaller vehicle although acceleration differences are negligible.

A coupled train of four vehicles having an overall length of 107 ft does not attain planing conditions at 30 mph.

RECOMMENDATIONS

Operational problems associated with the coupling of vehicles should be investigated. These should include, but not be limited to, the tactical aspects of coupled operations, the problems of coupling at sea, the problems of steering when coupled, the problems of coupled vehicles in surf, and the subsequent release for freedom to yaw necessary for land operations.

REFERENCES

1. Brady, P.M., Brown, P.W. and Kamm, I.O., "An Evaluation of the Coupled LVT Concept," Davidson Laboratory Report 2082, November 1979.

2. Brown, P.W. and Klosinski, W.E., "Modification for the LVTP-7 Bow Form to Improve Calm Water and Seakeeping Performance," Davidson Laboratory Technical Report 2074, December 1979.

3. Brown, P.W. and Klosinski, W.E., "An Investigation of Forced Air Ventilation of Amphibious Vehicle Tracks LVTP-7," Davidson Laboratory Technical Report 2104, December 1979.

4. Brown, P.W. and Klosinski, W.E., "The Contribution of Tracks to the Drag of an Amphibious Vehicle (LVTP-7)," Davidson Laboratory Technical Report 2109, December 1979.

5. Kamm, I.O. and Nazalewicz, J., "The Water Performance of Single and Coupled LVTP-7's with and without Bow Plane Extensions," Davidson Laboratory Report 2167, November 1980.

6. Numata, E. and Chiocco, M., "Effect of Low Freeboard on the Behavior of an Amphibious Vehicle in Head Seas," Davidson Laboratory Technical Report 2155, January 1981.

7. Brown, P.W., "Estimation of the Hydrodynamic Performance of Candidate LVT Amphibians," Davidson Laboratory Technical Report 2187, June 1981.

8. Brown, P.W. and Klosinski, W.E., "Experiments with Track Ventilation for Amphibious Tracked Vehicles and with Track Covers and Retraction," Davidson Laboratory Technical Report 2208, September 1981.

9. Kamm, I.O., "The AAI Coupled M-116 Vehicles," Davidson Laboratory Technical Report 2240, September 1981.

10. Wray, G., "Water Performance of an LVTP-7 with a Bow Plane Extension," Davidson Laboratory Report 2241, December 1981.

11. Brady, P.M., "Analysis of Obstacle Negotiation by Articulated Tracked Vehicle - The State of the Art," Davidson Laboratory Report 2245, December 1981.

12. Fridsma, G. and Klosinski, W.E., "Performance of a Small 14 Ton Tracked Amphibian in Calm and Rough Water," Davidson Laboratory Technical Report 2250, January 1982.

13. Van Dyck, R.L. and Ehrlich, I.R., "Drag Studies of Coupled Amphibians," Davidson Laboratory Report 1137, July 1966.

TABLE 1

PARTICULARS FOR 26 AND 14 TON LVT'S

	26 Ton LVT	14 Ton LVT
Displacement, lb	52,000	28,000
Length of Hull, in	308	251
Beam of Hull, in	127	103
Depth of Hull Hardstructure, in	81	66
Bow Flap:		
Length, in	36	29
Width, in	127	103
Angle, deg	26.57	26.57
Nominal LCG:		
Distance Aft of Bow, in	162.4	132.1
Forward of Midship, percent of length	-2.7	-2.7
Spacing Between LVT Units, ft (5.55 and 11.11% Hull Length)	1.425 2.85	1.16 2.32

		To Convert to 14 Ton LVT Multiply By
Drag, lb/short ton	-	1
Speed, mph	-	0.9
Trim, deg	-	1
Draft, ft	-	0.814

INDEX TO TABLES 2 THROUGH 16

TABLE	NUMBER OF UNITS	MODE OF TESTING	FIXED TRIM ANGLES, DEG	SPACING, % L	WATER ENVIRONMENT	WAVE HEADING	PHASE
2	1, 2, 3, 4	Free-to-Trim	-	5.6, 11.1	Calm Water		1
3	4	Fixed Trim	0, 2, 4, 6 Relative	[illegible]	Calm Water		1
4	4	Fixed Trim	2 Relative	5.6, 11.1	Calm Water		1
5	1, 2, 3, 4	Fixed Trim	2 Relative	5.6	Calm Water		2
6	4	Fixed Trim	Units 1 and 2 at 4, 6 Units 2, 3, 4 at 0	11.1	Calm Water		1
7	4	Fixed Trim	2, 6 Absolute	11.1	Calm Water		1
8	2-Two Train	Free-to-Trim	-	Various	Calm Water		1
9	4	Free-to-Trim	-	5.6	Sea State 2, 26 Ton	Head	1
10	4	Free-to-Trim	-	5.6	Sea State 2, 14 Ton	Head	1
11	4	Fixed Trim	2 Relative	5.6	Sea State 2, 14 Ton	Head	1
12	4	Fixed Trim	2 Relative	5.6	Sea State 2, 26 Ton	Following	1
13	4	Fixed Trim	2 Relative	5.6	Sea State 2, 14 Ton	Following	1
14	2	Fixed Trim	2 Relative	5.6	Sea State 2, 26 Ton	Head	2
15	3	Fixed Trim	2 Relative	5.6	Sea State 2, 26 Ton	Head	2
16A	4	Fixed Trim	2 Relative	5.6	Sea State 2, 26 Ton	Head	1
16B	4	Fixed Trim	2 Relative	5.6	Sea State 2, 26 Ton	Head	2

NOTE: In Tables 9 to 16 statistics are omitted when the number of oscillations is too small for reliable estimates of the average of the 1/3 and 1/10 highest quantities. The rule adopted is that 5 oscillations must be observed for inclusion of the statistics.

TABLE 2
CALM WATER PERFORMANCE
26 Ton Displacement

ONE, TWO, THREE, AND FOUR UNITS
FREE TO TRIM
1.425 FT AND 2.85 FT SPACING

RUN	SPEED MPH	SPEED LENGTH RATIO	LEADING VEHICLE DRAFT BEAMS	LEADING VEHICLE DRAG LB/STON	LEADING VEHICLE TRIM DEG	LEADING VEHICLE DRAFT FT	LINK FORCES BETWEEN VEHICLES LB/S-TON A	B	C	LINK ANGLES BETWEEN VEHICLES DEGREES A	B	C
1.425 FT SPACING, ONE UNIT												
18	0.00	0.00	0.42	0.	1.17	4.41						
19	4.01	0.69	0.42	22.	1.38	4.48						
20	6.00	1.03	0.43	49.	1.72	4.59						
21	8.00	1.37	0.45	116.	3.10	4.82						
22	9.99	1.71	0.47	204.	4.75	4.97						
23	12.01	2.06	0.48	425.	8.13	5.12						
24	13.87	2.38	0.50	909.	14.53	5.31						
1.425 FT SPACING, TWO UNITS												
33	0.00	0.00	0.41	0.	1.12	4.35	0.			0.10		
34	0.00	0.00	0.41	0.	1.11	4.38	0.			-0.05		
39	0.00	0.00	0.42	0.	1.11	4.40	0.			-0.01		
35	4.01	0.48	0.42	15.	1.27	4.45	7.			1.03		
36	6.00	0.72	0.43	32.	1.59	4.52	16.			2.70		
37	8.00	0.96	0.44	65.	2.60	4.69	32.			6.20		
38	9.99	1.19	0.45	143.	4.23	4.82	61.			11.90		
40	12.01	1.44	0.48	220.	7.89	5.05	19.			18.89		
41	12.01	1.44	0.47	221.	7.96	5.02	19.			19.43		
42	13.99	1.67	0.47	353.	11.47	5.00	26.			21.17		
1.425 FT SPACING, THREE UNITS												
25	0.00	0.00	0.41	0.	1.05	4.41	0.	0.		0.02	0.00	
27	4.01	0.39	0.42	11.	1.24	4.47	6.	5.		1.11	-0.18	
28	6.00	0.58	0.43	25.	1.56	4.56	14.	9.		2.64	-0.38	
29	8.00	0.78	0.45	49.	2.62	4.72	27.	20.		6.29	-0.80	
30	9.99	0.97	0.46	99.	4.26	4.85	44.	30.		12.12	-2.44	
31	12.01	1.17	0.47	187.	7.63	5.03	53.	94.		16.68	-4.75	
32	13.99	1.36	0.47	282.	11.61	5.00	59.	109.		17.79	-1.83	
1.425 FT SPACING, FOUR UNITS												
13	0.00	0.00	0.42	0.	1.14	4.41	0.	0.	0.	0.10	0.00	0.04
43	0.00	0.00	0.42	0.	1.15	4.41	0.	0.	0.	-0.15	0.02	-0.05
14	4.01	0.34	0.42	10.	1.34	4.47	6.	5.	3.	1.11	-0.22	-0.12
15	6.00	0.51	0.43	22.	1.67	4.55	14.	10.	7.	2.55	-0.51	-0.21
16	8.00	0.67	0.45	42.	2.78	4.72	25.	19.	13.	6.26	-1.08	-0.39
17	9.99	0.84	0.46	80.	4.33	4.84	39.	28.	24.	11.35	-2.69	-1.43
44	9.99	0.84	0.46	81.	4.40	4.83	39.	29.	25.	11.55	-2.89	-1.27
45	12.01	1.01	0.47	133.	7.70	4.98	34.	64.	26.	16.45	-4.55	0.13
46	13.99	1.18	0.46	231.	10.98	4.90	72.	108.	89.	15.41	-1.89	-3.42
47	13.99	1.18	0.46	231.	10.94	4.88	72.	108.	89.	15.38	-1.88	-3.43
48	15.85	1.33	0.43	341.	17.65	4.60	94.	100.	109.	19.29	-1.87	-2.16
2.850 FT SPACING, FOUR UNITS												
6	0.00	0.00	0.42	0.	1.09	4.45	0.	0.	0.	-0.30	0.06	0.02
7	8.16	0.67	0.45	53.	3.02	4.75	34.	26.		6.17	-0.55	0.15
5	8.17	0.67	0.44	54.	2.98	4.67	34.	26.	16.	10.20	3.63	5.91
8	9.81	0.81	0.46	89.	4.45	4.85	48.	33.		4.82	-1.70	-1.17
9	12.01	0.99	0.47	146.	7.66	4.99	50.	70.		14.72	4.16	1.24

TABLE 3

CALM WATER PERFORMANCE

FOUR UNITS
FIXED TRIM
2.85 FT SPACING
ZERO, TWO, FOUR, AND SIX DEGREE RELATIVE TRIMS

RUN	SPEED MPH	SPEED LENGTH RATIO	LEADING VEHICLE DRAFT BEAMS	DRAG LB/S-TON	TRIM DEG	DRAFT FT
ZERO DEG RELATIVE TRIM						
56	0.00	0.00	0.41	0.	-0.18	4.30
57	4.01	0.33	0.41	10.	-0.21	4.35
58	6.00	0.49	0.41	21.	-0.21	4.39
59	8.00	0.66	0.42	40.	-0.24	4.48
60	9.99	0.82	0.43	73.	-0.30	4.60
TWO DEG RELATIVE TRIM						
49	0.00	0.00	0.37	0.	2.65	3.92
50	4.01	0.33	0.37	9.	2.63	3.96
51	6.00	0.49	0.38	21.	2.60	4.01
52	8.00	0.66	0.39	39.	2.58	4.09
53	9.99	0.82	0.39	69.	2.60	4.15
54	12.01	0.99	0.39	111.	2.69	4.17
55	13.99	1.15	0.39	173.	2.95	4.16
FOUR DEG RELATIVE TRIM						
85	0.00	0.00	0.34	0.	5.21	3.57
91	0.00	0.00	0.34	0.	4.60	3.66
86	4.01	0.33	0.34	10.	5.17	3.62
87	5.99	0.49	0.35	22.	5.10	3.68
88	8.00	0.66	0.36	43.	5.06	3.76
92	8.00	0.66	0.36	41.	4.56	3.83
89	9.99	0.82	0.36	71.	5.04	3.80
93	9.99	0.82	0.37	70.	4.54	3.91
94	12.01	0.99	0.37	114.	4.67	3.97
95	13.99	1.15	0.37	182.	4.95	3.96
SIX DEG RELATIVE TRIM						
96	0.00	0.00	0.32	0.	6.59	3.37
98	4.01	0.33	0.32	10.	6.58	3.40
99	6.00	0.49	0.33	23.	6.56	3.48
100	8.00	0.66	0.34	49.	6.63	3.59

TABLE 4

CALM WATER PERFORMANCE

FOUR UNITS
FIXED TWO DEGREE RELATIVE TRIM
1.425 AND 2.85 FT SPACING

RUN	SPEED MPH	SPEED LENGTH RATIO	LEADING VEHICLE DRAFT BEAMS	DRAG LB/S-TON	TRIM DEG	DRAFT FT
2.85 FT SPACING						
49	0.00	0.00	0.37	0.	2.65	3.92
50	4.01	0.33	0.37	9.	2.63	3.96
51	6.00	0.49	0.38	21.	2.60	4.01
52	8.00	0.66	0.39	39.	2.58	4.09
53	9.99	0.82	0.39	69.	2.60	4.15
54	12.01	0.99	0.39	111.	2.69	4.17
55	13.99	1.15	0.39	173.	2.95	4.16
1.425 FT SPACING *						
105	0.00	0.00	0.38	0.	2.25	4.05
108	4.01	0.34	0.38	8.	2.29	4.07
109	6.00	0.50	0.39	19.	2.24	4.13
110	8.00	0.67	0.40	36.	2.21	4.20
111	9.99	0.84	0.40	62.	2.22	4.26
112	12.01	1.01	0.41	106.	2.36	4.31
113	13.95	1.17	0.41	165.	2.55	4.32

*See also Runs 215-222, Table 5

TABLE 5

CALM WATER PERFORMANCE

ONE, TWO, THREE, & FOUR UNITS
FIXED TRIM, TWO DEGREE RELATIVE
1.425 FT SPACING

			LEADING VEHICLE			
RUN	SPEED MPH	SPEED LENGTH RATIO	DRAFT BEAMS	DRAG LB/S-TON	TRIM DEG	DRAFT FT
ONE UNIT						
201	0.00		0.40	0.	1.20	4.38
TWO UNITS						
202	0.00		0.40	0.	1.09	4.22
203	4.99	0.60	0.41	18.	1.04	4.30
204	10.00	1.20	0.42	112.	1.11	4.49
205	14.99	1.79	0.42	341.	3.20	4.45
206	20.00	2.39	0.34	749.	6.51	3.63
207	24.99	2.99	0.22	948.	7.10	2.30
208	24.99	2.99	0.21	934.	7.17	2.27
THREE UNITS						
209	0.00		0.39	0.	1.74	4.11
210	4.99	0.49	0.40	15.	1.68	4.20
211	10.00	0.97	0.41	81.	1.65	4.38
212	15.00	1.46	0.43	229.	2.07	4.51
213	20.01	1.95	0.34	518.	4.98	3.60
214	24.93	2.42	0.19	750.	5.25	2.02
FOUR UNITS						
215	0.00		0.37	0.	2.32	3.94
216	4.99	0.42	0.38	13.	2.27	4.01
217	10.00	0.84	0.40	65.	2.22	4.18
218	14.99	1.26	0.40	185.	2.63	4.28
219	20.01	1.68	0.33	410.	4.86	3.52
220	24.91	2.09	0.17	587.	4.97	1.81
221	24.96	2.10	0.19	599.	4.82	2.01
222	29.58	2.49	0.16	716.	4.63	1.66

TABLE 6

CALM WATER PERFORMANCE

FOUR UNITS
FIXED TRIM
LEADING UNIT AT FOUR AND SIX DEGREES TRIM
RELATIVE TO SECOND UNIT-RELATIVE TRIM BETWEEN
UNITS TWO, THREE, AND FOUR IS ZERO DEGREES
2.85 FT. SPACING

RUN	SPEED MPH	SPEED LENGTH RATIO	LEADING VEHICLE DRAFT BEAMS	DRAG LB/S-TON	TRIM DEG	DRAFT FT
RELATIVE TRIM BETWEEN UNITS 1 & 2 FOUR DEG						
61	0.00	0.00	0.39	0.	3.19	4.11
62	4.01	0.33	0.39	10.	3.17	4.17
63	5.99	0.49	0.40	22.	3.13	4.21
64	8.00	0.66	0.41	41.	3.09	4.31
65	9.98	0.82	0.41	74.	3.11	4.33
66	12.01	0.99	0.41	116.	3.21	4.37
67	13.99	1.15	0.42	184.	3.41	4.47
RELATIVE TRIM BETWEEN UNITS 1 & 2 SIX DEG						
68	0.00	0.00	0.38	0.	4.66	3.99
69	8.00	0.66	0.40	42.	4.56	4.21
70	12.01	0.99	0.41	117.	4.62	4.32
71	13.99	1.15	0.41	185.	4.83	4.29

TABLE 7

CALM WATER PERFORMANCE

FOUR UNITS
FIXED TRIM, TWO AND SIX DEGREES ABSOLUTE
2.85 FT SPACING

RUN	SPEED MPH	SPEED LENGTH RATIO	LEADING VEHICLE DRAFT BEAMS	DRAG LB/S-TON	TRIM DEG	DRAFT FT
TWO DEGREES ABSOLUTE						
72	0.00	0.00	0.41	0.	2.25	4.36
73	4.01	0.33	0.41	11.	2.24	4.40
75	6.00	0.49	0.42	25.	2.21	4.46
74	8.00	0.66	0.43	46.	2.18	4.53
76	9.98	0.82	0.43	81.	2.22	4.58
77	12.01	0.99	0.44	129.	2.27	4.66
SIX DEGREES ABSOLUTE						
78	0.00	0.00	0.44	0.	6.04	4.63
101	0.00	0.00	0.44	0.	6.02	4.63
79	4.01	0.33	0.44	18.	6.02	4.65
80	5.99	0.49	0.44	41.	6.00	4.6[illegible]
81	8.00	0.66	0.45	70.	[illegible]	4.76
102	8.00	0.66	0.45	72.	5.94	4.74
82	9.99	0.82	0.45	116.	6.02	4.79
103	9.99	0.82	0.45	116.	6.01	4.74
83	12.01	0.99	0.45	168.	6.17	4.75
104	12.01	0.99	0.45	170.	6.10	4.79
84	13.99	1.15	0.46	264.	6.36	4.83

TABLE 8

CALM WATER PERFORMANCE

TWO 2-TRAIN UNITS
FREE TO TRIM
SPACING 1.425 FT AND VARIABLE SPACING

RUN	SPEED MPH	SPEED LENGTH RATIO	LEADING VEHICLE DRAFT BEAMS	LEADING VEHICLE DRAG LB/STON *	LEADING VEHICLE TRIM DEG	LEADING VEHICLE DRAFT FT	LINK FORCES BETWEEN VEHICLES LB/S-TON A	LINK FORCES B *	LINK FORCES C	LINK ANGLES BETWEEN VEHICLES DEGREES A	LINK ANGLES B *	LINK ANGLES C	SPACING FT	SPACING % LOA
1.425 FT SPACING														
127	0.00	0.00	0.41	0.	1.08	4.34	0.	0.	0.	0.00	0.00	0.00		
128	4.01	0.34	0.41	6.	1.22	4.40	1.	5.	3.	1.03	-0.75	-0.02		
129	6.00	0.50	0.42	12.	1.51	4.49	4.	11.	7.	2.59	-1.43	-0.05		
130	8.00	0.67	0.44	23.	2.54	4.66	6.	21.	13.	6.75	-2.77	-0.08		
131	9.98	0.84	0.45	55.	4.30	4.82	13.	29.	23.	13.81	-3.26	-0.21		
132	12.01	1.01	0.49	86.	9.35	5.16	-22.	67.	24.	23.88	-10.47	1.97		
VARYING SPACING														
132	12.01	1.01	0.49	86.	9.35	5.16	-22.	67.	24.	23.88	-10.47	1.97	1.4	5.6
133	12.01	0.99	0.48	84.	8.34	5.06	-18.	78.	26.	22.88	-12.59	5.90	5.9	23.1
134	12.01	0.95	0.48	88.	8.18	5.04	-13.	91.	29.	22.78	-12.71	8.79	14.9	58.2
137	12.01	0.93	0.47	99.	7.93	4.98	-1.	99.	33.	20.39	-11.29	10.55	20.2	78.6
136	12.01	0.91	0.47	106.	7.94	5.01	4.	102.	34.	19.92	-9.25	11.90	24.7	96.1
135	12.01	0.89	0.47	109.	7.88	4.98	7.	102.	35.	19.25	-7.64	13.14	32.9	128.3

* LEADING VEHICLE MEASURING DRAG OF UNITS 1 & 2
LINK FORCE B MEASURING DRAG OF UNITS 3 & 4
FORWARD END OF LINK B FIXED IN HEAVE BUT FREE-TO PIVOT
ABOUT A POINT 4.39 FEET ABOVE CALM WATER SURFACE

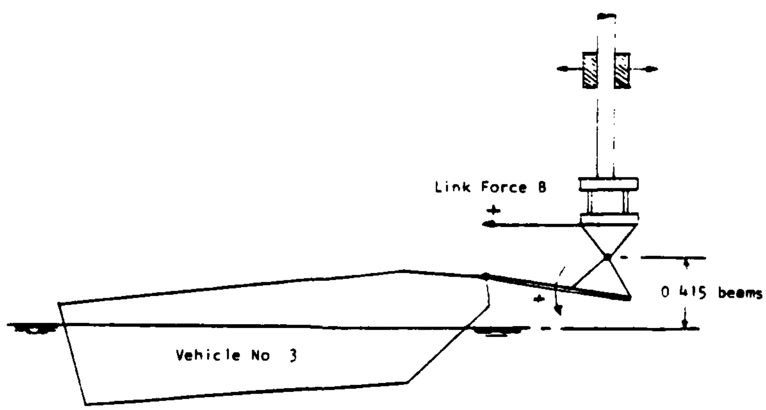


TABLE 9.1

IRREGULAR WAVE STATISTICS

VEHICLE DISPLACEMENT 26 SHORT TONS

TRAIN OF FOUR VEHICLES, SPACING 1.425 FT

HEAD SEAS

DAVIDSON LABORATORY 3-NOV-81

COUPLED AMPHIBIANS

RUN 144 FREE TO TRIM

SPEED 4.0 MPH WAVE ENCOUNTERS 114
WEIGHT 104.0 S-TONS SEA STATE 2
DRAG 27. LB/S-TON SPEED/LENGTH RATIO 0.337

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	2.517	82	6.55	9.05	11.11	13.74
	3.244	0.50	-1.46	-3.37	-4.41	-5.79
ACC A,G	-0.003	96	0.17	0.28	0.38	0.66
	0.107	0.10	-0.15	-0.23	-0.28	-0.32
HEAVE, FT	-0.664	67	-0.17	0.14	0.40	0.52
	0.394	0.15	-1.15	-1.46	-1.75	-1.98
PITCH A, DEG	5.111	99	13.22	20.21	23.64	25.75
	8.071	1.20	-4.46	-8.85	-11.40	-12.57
ACC B,G	-0.003	136	0.09	0.17	0.28	0.69
	0.070	0.10	-0.12	-0.20	-0.28	-0.37
PITCH B, DEG	2.950	85	13.11	19.24	23.24	28.26
	8.499	1.20	-7.81	-13.11	-14.05	-14.10
ACC C,G	-0.001	123	0.20	0.40	0.63	1.22
	0.096	0.10	-0.13	-0.21	-0.29	-0.42
PITCH C, DEG	3.617	86	14.05	19.78	22.46	24.64
	9.038	1.20	-8.54	-13.47	-13.79	-13.87
ACC D,G	-0.003	132	0.20	0.45	0.88	1.43
	0.098	0.10	-0.15	-0.22	-0.29	-0.36

TABLE 9.2

DAVIDSON LABORATORY 5-NOV-81

COUPLED AMPHIBIANS

RUN 147 FREE TO TRIM

SPEED 6.0 MPH WAVE ENCOUNTERS 80
WEIGHT 104.0 S-TONS SEA STATE 2
DRAG 54. LB/S-TON SPEED/LENGTH RATIO 0.504

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	2.881	61	6.78	9.20	10.93	12.36
	3.091	0.50	-0.85	-2.68	-3.66	-4.60
ACC A,G	-0.005	79	0.18	0.29	0.40	0.56
	0.122	0.10	-0.17	-0.26	-0.32	-0.39
HEAVE, FT	-0.749	50	-0.24	0.07	0.29	0.59
	0.406	0.15	-1.23	-1.58	-1.86	-1.97
PITCH A, DEG	5.901	70	14.04	21.29	25.53	26.12
	7.804	1.20	-3.14	-7.63	-9.97	-10.78
ACC B,G	-0.003	83	0.09	0.15	0.22	0.34
	0.058	0.10	-0.11	-0.18	-0.28	-0.41
PITCH B, DEG	2.038	62	12.49	19.84	25.21	27.41
	9.358	1.20	-9.56	-13.92	-15.36	-15.42
ACC C,G	0.000	115	0.18	0.34	0.57	1.05
	0.114	0.10	-0.15	-0.27	-0.37	-0.49
PITCH C, DEG	1.942	64	10.69	16.42	18.51	22.80
	7.569	1.20	-7.19	-12.13	-13.88	-14.46
ACC D,G	-0.015	134	0.16	0.35	0.63	1.28
	0.123	0.10	-0.26	-0.49	-0.75	-1.13

TABLE 9.3

DAVIDSON LABORATORY 3-NOV-81

COUPLED AMPHIBIANS

RUN 145 FREE TO TRIM

SPEED 8.0 MPH WAVE ENCOUNTERS 70
WEIGHT 104.0 S-TONS SEA STATE 2
DRAG 82. LB/S-TON SPEED/LENGTH RATIO 0.672

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	4.290	49	7.55	9.84	10.91	11.54
	2.637	0.50	1.13	-0.51	-1.53	-1.92
ACC A,G	-0.007	70	0.19	0.27	0.40	0.62
	0.127	0.10	-0.16	-0.28	-0.33	-0.35
HEAVE, FT	-0.948	42	-0.48	-0.13		0.12
	0.391	0.15	-1.40	-1.74		-2.10
PITCH A, DEG	9.188	56	16.35	21.59	24.37	25.75
	6.996	1.20	0.42	-3.52	-5.66	-7.58
ACC B,G	-0.004	44	0.10	0.13		0.17
	0.057	0.10	-0.10	-0.14		-0.20
PITCH B, DEG	-0.014	53	5.64	9.55	13.07	19.32
	5.212	1.20	-6.76	-9.50	-11.64	-13.92
ACC C,G	-0.001	46	0.13	0.21	0.28	0.38
	0.088	0.10	-0.12	-0.17	-0.22	-0.27
PITCH C, DEG	1.103	54	5.55	8.30	9.74	11.61
	3.678	1.20	-3.60	-6.50	-8.07	-9.64
ACC D,G	0.006	44	0.13	0.19		0.26
	0.084	0.10	-0.12	-0.17		-0.23

TABLE 9.4

DAVIDSON LABORATORY 5-NOV-81

COUPLED AMPHIBIANS

RUN 148 FREE TO TRIM

SPEED 10.0 MPH WAVE ENCOUNTERS 61
WEIGHT 104.0 S-TONS SEA STATE 2
DRAG 131. LB/S-TON SPEED/LENGTH RATIO 0.841

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	6.473	43	9.64	12.22		13.84
	2.905	0.50	3.26	1.21		-1.07
ACC A,G	-0.009	70	0.19	0.28	0.37	0.53
	0.138	0.10	-0.15	-0.28	-0.34	-0.39
HEAVE, FT	-1.246	37	-0.88	-0.49		-0.15
	0.394	0.15	-1.70	-2.09		-2.47
PITCH A, DEG	15.533	47	21.81	25.85	26.73	28.71
	6.870	1.20	8.15	1.20	-1.79	-5.36
ACC B,G	-0.004	45	0.08	0.11	0.13	0.15
	0.048	0.10	-0.09	-0.13	-0.16	-0.20
PITCH B, DEG	-2.585	46	2.82	5.84	8.67	11.34
	4.720	1.20	-8.28	-11.98	-13.26	-13.80
ACC C,G	-0.000	37	0.13	0.21		0.30
	0.091	0.10	-0.13	-0.19		-0.23
PITCH C, DEG	-0.012	46	3.14	5.48	6.96	7.44
	2.506	1.20	-3.09	-4.93	-6.55	-8.10
ACC D,G	0.002	40	0.14	0.22		0.29
	0.093	0.10	-0.13	-0.19		-0.27

TABLE 10.1

IRREGULAR WAVE STATISTICS

VEHICLE DISPLACEMENT 14 SHORT TONS

TRAIN OF FOUR VEHICLES, SPACING 1.16 FT

HEAD SEAS

DAVIDSON LABORATORY 5-NOV-81

COUPLED AMPHIBIANS

RUN 149 FREE TO TRIM

SPEED 4.0 MPH
WEIGHT 56.0 S-TONS
DRAG 38. LB/S-TON

WAVE ENCOUNTERS 87
SEA STATE 2
SPEED/LENGTH RATIO 0.373

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.003	73	7.85	11.32	13.57	17.03
	4.019	0.50	-1.66	-4.00	-5.34	-6.02
ACC A,G	-0.018	91	0.17	0.29	0.41	0.71
	0.129	0.10	-0.19	-0.30	-0.37	-0.41
HEAVE, FT	-0.635	60	-0.04	0.33	0.54	0.67
	0.474	0.15	-1.20	-1.57	-1.78	-2.12
PITCH A, DEG	6.909	83	16.94	23.97	25.96	26.00
	9.706	1.20	-5.02	-10.01	-13.32	-15.47
ACC B,G	-0.006	154	0.09	0.21	0.35	0.62
	0.073	0.10	-0.15	-0.27	-0.35	-0.51
PITCH B, DEG	3.263	83	13.94	24.28	30.73	33.17
	10.583	1.20	-9.28	-15.14	-15.60	-15.72
ACC C,G	-0.002	191	0.19	0.47	0.84	1.37
	0.128	0.10	-0.18	-0.33	-0.42	-0.63
PITCH C, DEG	3.087	82	12.99	19.33	22.20	23.93
	8.999	1.20	-8.15	-14.09	-14.60	-14.64
ACC D,G	-0.000	188	0.16	0.38	0.72	1.28
	0.118	0.10	-0.17	-0.29	-0.37	-0.48

TABLE 10.2

DAVIDSON LABORATORY 5-NOV-81

COUPLED AMPHIBIANS

RUN 153 FREE TO TRIM

SPEED 6.0 MPH WAVE ENCOUNTERS 65
WEIGHT 56.0 S-TONS SEA STATE 2
DRAG 72. LB/S-TON SPEED/LENGTH RATIO 0.559

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.677	54	8.10	10.61	12.10	14.24
	3.421	0.50	-0.52	-2.17	-2.85	-3.67
ACC A,G	-0.002	70	0.21	0.35	0.53	1.07
	0.137	0.10	-0.18	-0.28	-0.34	-0.38
HEAVE, FT	-0.693	42	-0.07	0.25		0.59
	0.469	0.15	-1.28	-1.64		-2.16
PITCH A, DEG	8.603	58	18.85	25.05	27.22	27.73
	8.848	1.20	-2.98	-7.94	-10.38	-11.40
ACC B,G	-0.003	67	0.09	0.15	0.18	0.20
	0.066	0.10	-0.11	-0.16	-0.20	-0.27
PITCH B, DEG	0.777	57	10.92	18.21	22.51	28.97
	9.186	1.20	-10.45	-15.51	-15.88	-15.90
ACC C,G	0.001	77	0.20	0.35	0.50	0.77
	0.113	0.10	-0.13	-0.21	-0.25	-0.27
PITCH C, DEG	2.162	55	11.95	17.43	20.11	21.31
	8.371	1.20	-8.73	-14.02	-14.46	-14.52
ACC D,G	0.001	77	0.21	0.46	0.80	1.05
	0.119	0.10	-0.19	-0.27	-0.33	-0.41

TABLE 10.3

DAVIDSON LABORATORY 5-NOV-81

COUPLED AMPHIBIANS

RUN 154 FREE TO TRIM

SPEED 8.0 MPH WAVE ENCOUNTERS 57
WEIGHT 56.0 S-TONS SEA STATE 2
DRAG 123. LB/S-TON SPEED/LENGTH RATIO 0.746

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	5.927	44	10.03	12.98		15.63
	3.463	0.50	2.00	0.19		-1.37
ACC A,G	-0.005	67	0.21	0.32	0.45	0.56
	0.151	0.10	-0.17	-0.33	-0.43	-0.50
HEAVE, FT	-0.981	35	-0.46	-0.05		0.38
	0.455	0.15	-1.48	-1.89		-2.39
PITCH A, DEG	13.904	47	22.21	26.51	27.69	27.79
	8.151	1.20	3.62	-2.63	-4.86	-5.67
ACC B,G	-0.003	42	0.10	0.15		0.19
	0.065	0.10	-0.11	-0.16		-0.30
PITCH B, DEG	-1.650	48	4.98	9.80	12.59	15.36
	5.710	1.20	-8.81	-12.23	-13.75	-14.94
ACC C,G	0.002	44	0.18	0.26		0.41
	0.119	0.10	-0.15	-0.22		-0.32
PITCH C, DEG	1.349	48	6.88	10.89	13.55	14.52
	4.797	1.20	-4.17	-8.19	-11.25	-14.29
ACC D,G	0.019	49	0.18	0.32	0.43	0.64
	0.126	0.10	-0.18	-0.33	-0.55	-0.67

TABLE 11.1

IRREGULAR WAVE STATISTICS

VEHICLE DISPLACEMENT 14 SHORT TONS

TRAIN OF FOUR VEHICLES, SPACING 1.16 FT

HEAD SEAS

DAVIDSON LABORATORY 5-NOV-81

COUPLED AMPHIBIANS

RUN 161 FIXED TRIM, 2 DEGREES RELATIVE TRIM

SPEED 4.0 MPH WAVE ENCOUNTERS 93
WEIGHT 56.0 S-TONS SEA STATE 2
DRAG 23. LB/S-TON SPEED/LENGTH RATIO 0.373

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.252	49	4.13	4.63	4.98	5.24
	0.632	0.50	2.34	1.91	1.56	1.30
ACC A,G	0.009	55	0.11	0.15	0.19	0.30
	0.054	0.10	-0.09	-0.13	-0.15	-0.17
HEAVE, FT	-0.329	60	0.11	0.47	0.71	0.89
	0.399	0.15	-0.78	-1.11	-1.30	-1.38
PITCH A, DEG	0.016	0	0.00	0.00	0.00	0.00
	0.050	1.20	0.00	0.00	0.00	0.00
ACC B,G	0.042	24	0.12	0.14		0.15
	0.026	0.10	-0.02	-0.04		-0.07
PITCH B, DEG	0.020	0	0.00	0.00	0.00	0.00
	0.045	1.20	0.00	0.00	0.00	0.00
ACC C,G	-0.003	12	0.07			0.11
	0.018	0.10	-0.06			-0.10
PITCH C, DEG	0.016	0	0.00	0.00	0.00	0.00
	0.047	1.20	0.00	0.00	0.00	0.00
ACC D,G	-0.001	30	0.07	0.09		0.12
	0.031	0.10	-0.07	-0.09		-0.13

TABLE 11.2

DAVIDSON LABORATORY 5-NOV-81

COUPLED AMPHIBIANS

RUN 162 FIXED TRIM, 2 DEGREES RELATIVE TRIM

SPEED 6.0 MPH WAVE ENCOUNTERS 67
WEIGHT 56.0 S-TONS SEA STATE 2
DRAG 41. LB/S-TON SPEED/LENGTH RATIO 0.559

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.073	36	3.84	4.33		4.97
	0.579	0.50	2.34	1.93		1.32
ACC A,G	-0.002	52	0.11	0.18	0.24	0.40
	0.059	0.10	-0.10	-0.15	-0.19	-0.24
HEAVE, FT	-0.232	38	0.23	0.53		0.89
	0.378	0.15	-0.67	-0.97		-1.55
PITCH A, DEG	0.015	0	0.00	0.00	0.00	0.00
	0.050	1.20	0.00	0.00	0.00	0.00
ACC B,G	-0.002	20	0.08	0.10		0.14
	0.029	0.10	-0.07	-0.10		-0.15
PITCH B, DEG	0.022	0	0.00	0.00	0.00	0.00
	0.040	1.20	0.00	0.00	0.00	0.00
ACC C,G	0.001	12	0.06			0.11
	0.020	0.10	-0.07			-0.14
PITCH C, DEG	0.014	0	0.00	0.00	0.00	0.00
	0.048	1.20	0.00	0.00	0.00	0.00
ACC D,G	0.001	22	0.08	0.10		0.13
	0.033	0.10	-0.08	-0.11		-0.20

TABLE 11.3

DAVIDSON LABORATORY 5-NOV-81

COUPLED AMPHIBIANS

RUN 163 FIXED TRIM, 2 DEGREES RELATIVE TRIM

SPEED 8.0 MPH WAVE ENCOUNTERS 56
WEIGHT 56.0 S-TONS SEA STATE 2
DRAG 74. LB/S-TON SPEED/LENGTH RATIO 0.746

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	2.989	23	3.79	4.16		4.57
	0.529	0.50	2.18	1.63		1.40
ACC A,G	-0.002	54	0.11	0.18	0.23	0.31
	0.059	0.10	-0.10	-0.16	-0.20	-0.27
HEAVE, FT	-0.431	29	-0.01	0.27		0.66
	0.370	0.15	-0.83	-1.21		-1.61
PITCH A, DEG	0.015	0	0.00	0.00	0.00	0.00
	0.049	1.20	0.00	0.00	0.00	0.00
ACC B,G	-0.001	26	0.08	0.11		0.15
	0.031	0.10	-0.07	-0.10		-0.12
PITCH B, DEG	0.022	0	0.00	0.00	0.00	0.00
	0.041	1.20	0.00	0.00	0.00	0.00
ACC C,G	0.002	18	0.07	0.08		0.09
	0.023	0.10	-0.06	-0.08		-0.10
PITCH C, DEG	0.014	0	0.00	0.00	0.00	0.00
	0.048	1.20	0.00	0.00	0.00	0.00
ACC D,G	0.002	24	0.08	0.09		0.12
	0.033	0.10	-0.07	-0.09		-0.12

TABLE 12.1

IRREGULAR WAVE STATISTICS

VEHICLE DISPLACEMENT 26 SHORT TONS

TRAIN OF FOUR VEHICLES, SPACING 1.425 FT

FOLLOWING SEAS

DAVIDSON LABORATORY 6-NOV-81

COUPLED AMPHIBIANS

RUN 164 FIXED TR 2 DEGREES RELATIVE TRIM, FOLLOWING SEAS

SPEED 4.1 MPH WAVE ENCOUNTERS 38
WEIGHT 104.0 S-TONS SEA STATE 2
DRAG 13. LB/S-TON SPEED/LENGTH RATIO 0.347

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	2.960	21	3.41	3.59		3.65
	0.278	0.50	2.50	2.35		2.15
ACC A,G	0.007	0	0.00	0.00	0.00	0.00
	0.008	0.10	0.00	0.00	0.00	0.00
HEAVE, FT	-0.211	26	0.04	0.19		0.30
	0.185	0.15	-0.45	-0.58		-0.70
PITCH A, DEG	0.014	0	0.00	0.00	0.00	0.00
	0.052	1.20	0.00	0.00	0.00	0.00
ACC B,G	-0.007	0	0.00	0.00	0.00	0.00
	0.002	0.10	0.00	0.00	0.00	0.00
PITCH B, DEG	0.023	0	0.00	0.00	0.00	0.00
	0.040	1.20	0.00	0.00	0.00	0.00
ACC C,G	-0.000	0	0.00	0.00	0.00	0.00
	0.004	0.10	0.00	0.00	0.00	0.00
PITCH C, DEG	0.012	0	0.00	0.00	0.00	0.00
	0.050	1.20	0.00	0.00	0.00	0.00
ACC D,G	-0.002	0	0.00	0.00	0.00	0.00
	0.006	0.10	0.00	0.00	0.00	0.00

TABLE 12.2

DAVIDSON LABORATORY 6-NOV-81

COUPLED AMPHIBIANS

RUN 165 FIXED TRIM, 2 DEGREES RELATIVE TRIM, FOLLOWING SEAS

SPEED 5.9 MPH WAVE ENCOUNTERS 18
WEIGHT 104.0 S-TONS SEA STATE 2
DRAG 22. LB/S-TON SPEED/LENGTH RATIO 0.499

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.029	13	3.54			3.77
	0.317	0.50	2.46			2.10
ACC A,G	0.014	0	0.00	0.00	0.00	0.00
	0.008	0.10	0.00	0.00	0.00	0.00
HEAVE, FT	-0.267	16	0.02	0.15		0.26
	0.208	0.15	-0.55	-0.69		-0.78
PITCH A, DEG	0.015	0	0.00	0.00	0.00	0.00
	0.051	1.20	0.00	0.00	0.00	0.00
ACC B,G	-0.008	0	0.00	0.00	0.00	0.00
	0.002	0.10	0.00	0.00	0.00	0.00
PITCH B, DEG	0.023	0	0.00	0.00	0.00	0.00
	0.039	1.20	0.00	0.00	0.00	0.00
ACC C,G	-0.000	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
PITCH C, DEG	0.012	0	0.00	0.00	0.00	0.00
	0.049	1.20	0.00	0.00	0.00	0.00
ACC D,G	0.003	0	0.00	0.00	0.00	0.00
	0.005	0.10	0.00	0.00	0.00	0.00

TABLE 12.3

DAVIDSON LABORATORY 6-NOV-81

COUPLED AMPHIBIANS

RUN 166 FIXED TRIM, 2 DEGREES RELATIVE TRIM, FOLLOWING SEAS

SPEED 7.9 MPH WAVE ENCOUNTERS 14
WEIGHT 104.0 S-TONS SEA STATE 2
DRAG 40. LB/S-TON SPEED/LENGTH RATIO 0.661

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.107	9	3.90			4.20
	0.510	0.50	2.38			2.27
ACC A,G	0.023	0	0.00	0.00	0.00	0.00
	0.008	0.10	0.00	0.00	0.00	0.00
HEAVE, FT	-0.372	9	0.10			0.23
	0.316	0.15	-0.80			-0.89
PITCH A, DEG	0.015	0	0.00	0.00	0.00	0.00
	0.051	1.20	0.00	0.00	0.00	0.00
ACC B,G	-0.007	0	0.00	0.00	0.00	0.00
	0.002	0.10	0.00	0.00	0.00	0.00
PITCH B, DEG	0.022	0	0.00	0.00	0.00	0.00
	0.040	1.20	0.00	0.00	0.00	0.00
ACC C,G	0.000	0	0.00	0.00	0.00	0.00
	0.004	0.10	0.00	0.00	0.00	0.00
PITCH C, DEG	0.013	0	0.00	0.00	0.00	0.00
	0.051	1.20	0.00	0.00	0.00	0.00
ACC D,G	0.005	0	0.00	0.00	0.00	0.00
	0.005	0.10	0.00	0.00	0.00	0.00

TABLE 12.4

DAVIDSON LABORATORY 6-NOV-81

COUPLED AMPHIBIANS

RUN 167 FIXED TRIM, 2 DEGREES RELATIVE TRIM, FOLLOWING SEAS

SPEED 10.0 MPH WAVE ENCOUNTERS 9
WEIGHT 104.0 S-TONS SEA STATE 2
DRAG 67. LB/S-TON SPEED/LENGTH RATIO 0.845

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.195	5	3.86			4.02
	0.373	0.50	2.60			2.32
ACC A,G	-0.004	0	0.00	0.00	0.00	0.00
	0.007	0.10	0.00	0.00	0.00	0.00
HEAVE, FT	-0.464	6	-0.16			-0.01
	0.229	0.15	-0.75			-0.98
PITCH A, DEG	0.015	0	0.00	0.00	0.00	0.00
	0.052	1.20	0.00	0.00	0.00	0.00
ACC B,G	-0.003	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
PITCH B, DEG	0.021	0	0.00	0.00	0.00	0.00
	0.041	1.20	0.00	0.00	0.00	0.00
ACC C,G	-0.002	0	0.00	0.00	0.00	0.00
	0.004	0.10	0.00	0.00	0.00	0.00
PITCH C, DEG	0.013	0	0.00	0.00	0.00	0.00
	0.049	1.20	0.00	0.00	0.00	0.00
ACC D,G	-0.003	0	0.00	0.00	0.00	0.00
	0.005	0.10	0.00	0.00	0.00	0.00

TABLE 12.5

DAVIDSON LABORATORY 6-NOV-81

COUPLED AMPHIBIANS

RUN 168 FIXED TRIM, 2 DEGREES RELATIVE TRIM, FOLLOWING SEAS

SPEED 12.0 MPH WAVE ENCOUNTERS 17
WEIGHT 104.0 S-TONS SEA STATE 2
DRAG 111. LB/S-TON SPEED/LENGTH RATIO 1.011

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.476	2	3.87			3.87
	0.243	0.50	2.91			2.80
ACC A,G	-0.004	0	0.00	0.00	0.00	0.00
	0.008	0.10	0.00	0.00	0.00	0.00
HEAVE, FT	-0.593	5	-0.37			-0.31
	0.200	0.15	-0.79			-1.06
PITCH A, DEG	0.016	0	0.00	0.00	0.00	0.00
	0.050	1.20	0.00	0.00	0.00	0.00
ACC B,G	-0.001	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
PITCH B, DEG	0.022	0	0.00	0.00	0.00	0.00
	0.040	1.20	0.00	0.00	0.00	0.00
ACC C,G	-0.000	0	0.00	0.00	0.00	0.00
	0.005	0.10	0.00	0.00	0.00	0.00
PITCH C, DEG	0.013	0	0.00	0.00	0.00	0.00
	0.049	1.20	0.00	0.00	0.00	0.00
ACC D,G	-0.001	0	0.00	0.00	0.00	0.00
	0.005	0.10	0.00	0.00	0.00	0.00

TABLE 13.1

IRREGULAR WAVE STATISTICS

VEHICLE DISPLACEMENT 14 SHORT TONS

TRAIN OF FOUR VEHICLES, SPACING 1.16 FT

FOLLOWING SEAS

DAVIDSON LABORATORY 6-NOV-81

COUPLED AMPHIBIANS

RUN 169 FIXED TRIM, 2 DEGREES RELATIVE TRIM, FOLLOWING SEAS

SPEED 4.0 MPH WAVE ENCOUNTERS 31
WEIGHT 56.0 S-TONS SEA STATE 2
DRAG 17. LB/S-TON SPEED/LENGTH RATIO 0.374

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.063	21	3.80	4.26		4.62
	0.566	0.50	2.22	1.78		1.40
ACC A,G	-0.008	0	0.00	0.00	0.00	0.00
	0.013	0.10	0.00	0.00	0.00	0.00
HEAVE, FT	-0.254	23	0.10	0.33		0.56
	0.287	0.15	-0.62	-0.87		-1.06
PITCH A, DEG	0.015	0	0.00	0.00	0.00	0.00
	0.051	1.20	0.00	0.00	0.00	0.00
ACC B,G	0.000	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
PITCH B, DEG	0.022	0	0.00	0.00	0.00	0.00
	0.040	1.20	0.00	0.00	0.00	0.00
ACC C,G	0.002	0	0.00	0.00	0.00	0.00
	0.005	0.10	0.00	0.00	0.00	0.00
PITCH C, DEG	0.014	0	0.00	0.00	0.00	0.00
	0.049	1.20	0.00	0.00	0.00	0.00
ACC D,G	0.000	0	0.00	0.00	0.00	0.00
	0.009	0.10	0.00	0.00	0.00	0.00

TABLE 13.2

DAVIDSON LABORATORY 6-NOV-81

COUPLED AMPHIBIANS

RUN 170 FIXED TRIM, 2 DEGREES RELATIVE TRIM, FOLLOWING SEAS

SPEED 6.0 MPH WAVE ENCOUNTERS 14
WEIGHT 56.0 S-TONS SEA STATE 2
DRAG 30. LB/S-TON SPEED/LENGTH RATIO 0.560

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.139	12	4.04			4.55
	0.666	0.50	2.20			1.57
ACC A,G	-0.007	0	0.00	0.00	0.00	0.00
	0.011	0.10	0.00	0.00	0.00	0.00
HEAVE, FT	-0.322	13	0.11			0.35
	0.313	0.15	-0.75			-0.95
PITCH A, DEG	0.016	0	0.00	0.00	0.00	0.00
	0.050	1.20	0.00	0.00	0.00	0.00
ACC B,G	0.001	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
PITCH B, DEG	0.021	0	0.00	0.00	0.00	0.00
	0.040	1.20	0.00	0.00	0.00	0.00
ACC C,G	0.003	0	0.00	0.00	0.00	0.00
	0.004	0.10	0.00	0.00	0.00	0.00
PITCH C, DEG	0.014	0	0.00	0.00	0.00	0.00
	0.049	1.20	0.00	0.00	0.00	0.00
ACC D,G	0.001	0	0.00	0.00	0.00	0.00
	0.007	0.10	0.00	0.00	0.00	0.00

TABLE 13.3

DAVIDSON LABORATORY 6-NOV-81

COUPLED AMPHIBIANS

RUN 171 FIXED TRIM, 2 DEGREES RELATIVE TRIM, FOLLOWING SEAS

SPEED 8.0 MPH WAVE ENCOUNTERS 10
WEIGHT 56.0 S-TONS SEA STATE 2
DRAG 59. LB/S-TON SPEED/LENGTH RATIO 0.746

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.325	7	4.00			4.40
	0.459	0.50	2.59			2.25
ACC A,G	-0.006	0	0.00	0.00	0.00	0.00
	0.008	0.10	0.00	0.00	0.00	0.00
HEAVE, FT	-0.424	9	-0.20			-0.08
	0.189	0.15	-0.67			-0.90
PITCH A, DEG	0.015	0	0.00	0.00	0.00	0.00
	0.050	1.20	0.00	0.00	0.00	0.00
ACC B,G	0.001	0	0.00	0.00	0.00	0.00
	0.002	0.10	0.00	0.00	0.00	0.00
PITCH B, DEG	0.021	0	0.00	0.00	0.00	0.00
	0.040	1.20	0.00	0.00	0.00	0.00
ACC C,G	0.003	0	0.00	0.00	0.00	0.00
	0.004	0.10	0.00	0.00	0.00	0.00
PITCH C, DEG	0.013	0	0.00	0.00	0.00	0.00
	0.049	1.20	0.00	0.00	0.00	0.00
ACC D,G	0.001	0	0.00	0.00	0.00	0.00
	0.006	0.10	0.00	0.00	0.00	0.00

TABLE 13.4

DAVIDSON LABORATORY 6-NOV-81

COUPLED AMPHIBIANS

RUN 172 FIXED TRIM, 2 DEGREES RELATIVE TRIM, FOLLOWING SEAS

SPEED 10.0 MPH WAVE ENCOUNTERS 11
WEIGHT 56.0 S-TONS SEA STATE 2
DRAG 101. LB/S-TON SPEED/LENGTH RATIO 0.931

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.597	3	4.05			4.15
	0.317	0.50	3.01			2.87
ACC A,G	-0.006	0	0.00	0.00	0.00	0.00
	0.008	0.10	0.00	0.00	0.00	0.00
HEAVE, FT	-0.558	3	-0.27			-0.18
	0.199	0.15	-0.82			-0.91
PITCH A, DEG	0.016	0	0.00	0.00	0.00	0.00
	0.049	1.20	0.00	0.00	0.00	0.00
ACC B,G	0.001	0	0.00	0.00	0.00	0.00
	0.002	0.10	0.00	0.00	0.00	0.00
PITCH B, DEG	0.022	0	0.00	0.00	0.00	0.00
	0.040	1.20	0.00	0.00	0.00	0.00
ACC C,G	0.004	0	0.00	0.00	0.00	0.00
	0.004	0.10	0.00	0.00	0.00	0.00
PITCH C, DEG	0.013	0	0.00	0.00	0.00	0.00
	0.049	1.20	0.00	0.00	0.00	0.00
ACC D,G	-0.000	0	0.00	0.00	0.00	0.00
	0.005	0.10	0.00	0.00	0.00	0.00

TABLE 14.1

IRREGULAR WAVE STATISTICS

VEHICLE DISPLACEMENT 26 SHORT TONS

TRAIN OF TWO VEHICLES, SPACING 1.425 FT

HEAD SEAS

DAVIDSON LABORATORY 21-DEC-81

COUPLED AMPHIBIANS

RUN 237 FIXED TRIM, 2 DEGREES RELATIVE TRIM

SPEED 5.0 MPH WAVE ENCOUNTERS 88
WEIGHT 52.0 S-TONS SEA STATE 2
DRAG 38. LB/S-TON SPEED/LENGTH RATIO 0.597

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	1.217	60	3.02	4.21	5.08	5.68
	1.479	0.50	-0.54	-1.72	-2.49	-3.01
ACC A, G	-0.003	70	0.15	0.23	0.31	0.43
	0.093	0.10	-0.12	-0.20	-0.24	-0.29
HEAVE, FT	-0.404	60	0.06	0.38	0.66	0.78
	0.402	0.15	-0.87	-1.24	-1.44	-1.63
ACC B, G	0.000	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC C, G	0.000	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC D, G	-0.003	34	0.09	0.13		0.29
	0.031	0.10	-0.08	-0.11		-0.20

TABLE 14.2

DAVIDSON LABORATORY 21-DEC-81

COUPLED AMPHIBIANS

RUN 238

SPEED 10.0 MPH WAVE ENCOUNTERS 53
WEIGHT 52.0 S-TONS SEA STATE 2
DRAG 152. LB/S-TON SPEED/LENGTH RATIO 1.197

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	0.663	29	1.82	2.31		2.67
	0.851	0.50	-0.46	-1.16		-1.46
ACC A, G	-0.001	65	0.11	0.16	0.19	0.21
	0.070	0.10	-0.09	-0.15	-0.18	-0.21
HEAVE, FT	-0.960	28	-0.58	-0.42		-0.35
	0.293	0.15	-1.35	-1.57		-1.71
ACC B, G	0.000	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC C, G	0.000	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC D, G	-0.002	45	0.08	0.12	0.14	0.15
	0.037	0.10	-0.08	-0.11	-0.12	-0.13

TABLE 14.3

DAVIDSON LABORATORY 21-DEC-81

COUPLED AMPHIBIANS

RUN 239

SPEED 15.0 MPH WAVE ENCOUNTERS 49
WEIGHT 52.0 S-TONS SEA STATE 2
DRAG 398. LB/S-TON SPEED/LENGTH RATIO 1.794

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	3.108	20	3.95	4.45		4.89
	0.625	0.50	2.23	1.69		0.98
ACC A, G	-0.004	36	0.10	0.16		0.24
	0.066	0.10	-0.12	-0.19		-0.24
HEAVE, FT	-1.091	17	-0.82	-0.65		-0.52
	0.215	0.15	-1.38	-1.56		-1.60
ACC B, G	0.000	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC C, G	0.000	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC D, G	-0.002	17	0.08	0.11		0.16
	0.036	0.10	-0.07	-0.10		-0.11

TABLE 14.4

DAVIDSON LABORATORY 21-DEC-81

COUPLED AMPHIBIANS

RUN 240

SPEED 20.0 MPH WAVE ENCOUNTERS 43
WEIGHT 52.0 S-TONS SEA STATE 2
DRAG 763. LB/S-TON SPEED/LENGTH RATIO 2.394

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	7.490	18	8.23	8.83		9.20
	0.611	0.50	6.73	6.22		5.80
ACC A, G	-0.008	35	0.16	0.24		0.32
	0.101	0.10	-0.13	-0.21		-0.32
HEAVE, FT	0.256	20	0.45	0.67		0.77
	0.236	0.15	0.03	-0.21		-0.53
ACC B, G	0.000	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC C, G	0.000	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC D, G	-0.009	16	0.06	0.08		0.10
	0.028	0.10	-0.07	-0.08		-0.11

TABLE 14.5

DAVIDSON LABORATORY 21-DEC-81

COUPLED AMPHIBIANS

RUN 241

SPEED 24.9 MPH WAVE ENCOUNTERS 40
WEIGHT 52.0 S-TONS SEA STATE 2
DRAG 932. LB/S-TON SPEED/LENGTH RATIO 2.983

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	8.376	19	9.13	9.58		9.84
	0.570	0.50	7.83	7.62		7.58
ACC A, G	-0.008	49	0.19	0.32	0.44	0.62
	0.140	0.10	-0.14	-0.27	-0.35	-0.38
HEAVE, FT	1.769	18	2.04	2.41		2.70
	0.465	0.15	1.67	1.35		1.11
ACC B, G	0.000	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC C, G	0.000	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC D, G	-0.015	37	0.08	0.12		0.21
	0.041	0.10	-0.08	-0.11		-0.15

TABLE 15.1

IRREGULAR WAVE STATISTICS

VEHICLE DISPLACEMENT 26 SHORT TONS

TRAIN OF THREE VEHICLES, SPACING 1.425 FT

HEAD SEAS

DAVIDSON LABORATORY 21-DEC-81

COUPLED AMPHIBIANS

RUN 231 FIXED TRIM, 2 DEGREES RELATIVE TRIM

SPEED 5.0 MPH WAVE ENCOUNTERS 91
WEIGHT 78. S-TONS SEA STATE 2
DRAG 26. LB/S-TON SPEED/LENGTH RATIO 0.487

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	1.723	51	2.63	3.28	3.71	4.04
	0.729	0.50	0.75	0.09	-0.32	-0.46
ACC A, G	-0.014	66	0.11	0.19	0.29	0.55
	0.060	0.10	-0.10	-0.15	-0.18	-0.22
HEAVE, FT	-0.331	55	0.06	0.38	0.63	0.76
	0.358	0.15	-0.75	-1.08	-1.29	-1.40
ACC B, G	-0.002	17	0.10	0.14		0.20
	0.018	0.10	-0.07	-0.11		-0.14
ACC C, G	0.001	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC D, G	-0.002	45	0.08	0.12	0.17	0.26
	0.032	0.10	-0.08	-0.12	-0.15	-0.19

TABLE 15.2

DAVIDSON LABORATORY 21-DEC-81

COUPLED AMPHIBIANS

RUN 232

SPEED 10.0 MPH WAVE ENCOUNTERS 56
WEIGHT 78. S-TONS SEA STATE 2
DRAG 100. LB/S-TON SPEED/LENGTH RATIO 0.972

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	1.624	24	2.40	2.85		3.08
	0.550	0.50	0.85	0.40		0.02
ACC A, G	-0.010	63	0.11	0.19	0.29	0.54
	0.060	0.10	-0.11	-0.15	-0.18	-0.20
HEAVE, FT	-0.686	25	-0.30	-0.08		-0.01
	0.301	0.15	-1.08	-1.33		-1.53
ACC B, G	-0.002	22	0.08	0.12		0.16
	0.023	0.10	-0.06	-0.09		-0.12
ACC C, G	0.001	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC D, G	-0.001	45	0.07	0.10	0.12	0.13
	0.035	0.10	-0.08	-0.13	-0.18	-0.24

TABLE 15.3

DAVIDSON LABORATORY 21-DEC-81

COUPLED AMPHIBIANS

RUN 233

SPEED 15.0 MPH
WEIGHT 78.0 S-TONS
DRAG 267. LB/S-TON

WAVE ENCOUNTERS 50
SEA STATE 2
SPEED/LENGTH RATIO 1.458

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	2.197	18	2.75	3.01		3.20
	0.430	0.50	1.46	0.94		0.43
ACC A, G	-0.012	50	0.07	0.12	0.17	0.22
	0.049	0.10	-0.11	-0.15	-0.19	-0.22
HEAVE, FT	-1.080	18	-0.89	-0.72		-0.52
	0.226	0.15	-1.34	-1.51		-1.63
ACC B, G	-0.002	16	0.07	0.10		0.16
	0.024	0.10	-0.07	-0.09		-0.15
ACC C, G	0.001	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC D, G	0.001	23	0.09	0.12		0.16
	0.036	0.10	-0.07	-0.10		-0.15

TABLE 15.4

DAVIDSON LABORATORY 21-DEC-81

COUPLED AMPHIBIANS

RUN 234

SPEED 20.0 MPH WAVE ENCOUNTERS 45
WEIGHT 78.0 S-TONS SEA STATE 2
DRAG 541. LB/S-TON SPEED/LENGTH RATIO 1.946

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	5.759	18	6.36	6.76		6.83
	0.476	0.50	5.30	5.03		4.73
ACC A, G	-0.017	45	0.12	0.19	0.27	0.34
	0.073	0.10	-0.11	-0.16	-0.20	-0.27
HEAVE, FT	0.217	16	0.41	0.64		0.83
	0.261	0.15	0.05	-0.26		-0.56
ACC B, G	-0.003	15	0.09	0.14		0.17
	0.032	0.10	-0.07	-0.09		-0.14
ACC C, G	0.001	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC D, G	-0.004	17	0.06	0.09		0.14
	0.030	0.10	-0.09	-0.13		-0.16

TABLE 15.5

DAVIDSON LABORATORY 21-DEC-81

COUPLED AMPHIBIANS

RUN 235

SPEED 24.8 MPH WAVE ENCOUNTERS 41
WEIGHT 78.0 S-TONS SEA STATE 2
DRAG 768. LB/S-TON SPEED/LENGTH RATIO 2.412

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	6.827	23	7.39	7.71		8.06
	0.470	0.50	6.39	6.16		5.64
ACC A, G	-0.016	54	0.14	0.25	0.36	0.52
	0.106	0.10	-0.15	-0.24	-0.29	-0.32
HEAVE, FT	1.661	15	1.84	2.27		2.46
	0.562	0.15	1.57	1.17		0.85
ACC B, G	-0.004	23	0.09	0.12		0.20
	0.041	0.10	-0.08	-0.11		-0.16
ACC C, G	0.001	0	0.00	0.00	0.00	0.00
	0.003	0.10	0.00	0.00	0.00	0.00
ACC D, G	-0.009	32	0.07	0.10		0.22
	0.037	0.10	-0.09	-0.12		-0.19

TABLE 16A.1 (PHASE 1)

IRREGULAR WAVE STATISTICS

VEHICLE DISPLACEMENT 26 SHORT TONS

TRAIN OF FOUR VEHICLES, SPACING 1.425 FT

HEAD SEAS

DAVIDSON LABORATORY 5-NOV-81

COUPLED AMPHIBIANS

RUN 156 FIXED TRIM, 2 DEG. RELATIVE TRIM

SPEED 4.0 MPH WAVE ENCOUNTERS 103
WEIGHT 104.0 S-TONS SEA STATE 2
DRAG 16. LB/S-TON SPEED/LENGTH RATIO 0.337

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.127	50	3.76	4.08	4.30	4.45
	0.423	0.50	2.51	2.21	1.99	1.77
ACC A,G	0.004	54	0.09	0.13	0.18	0.31
	0.039	0.10	-0.07	-0.10	-0.13	-0.17
HEAVE, FT	-0.190	60	0.21	0.45	0.64	0.73
	0.325	0.15	-0.60	-0.86	-1.04	-1.13
PITCH A, DEG	0.015	0	0.00	0.00	0.00	0.00
	0.051	1.20	0.00	0.00	0.00	0.00
ACC B,G	-0.002	8	0.06			0.09
	0.019	0.10	-0.07			-0.13
PITCH B, DEG	0.022	0	0.00	0.00	0.00	0.00
	0.040	1.20	0.00	0.00	0.00	0.00
ACC C,G	-0.002	5	0.06			0.08
	0.018	0.10	-0.06			-0.07
PITCH C, DEG	0.014	0	0.00	0.00	0.00	0.00
	0.048	1.20	0.00	0.00	0.00	0.00
ACC D,G	-0.002	14	0.06	0.08		0.11
	0.023	0.10	-0.06	-0.08		-0.10

TABLE 16A.2

DAVIDSON LABORATORY 5-NOV-81

COUPLED AMPHIBIANS

RUN 157 FIXED TRIM, 2 DEGREES RELATIVE TRIM

SPEED 6.0 MPH WAVE ENCOUNTERS 76
WEIGHT 104.0 S-TONS SEA STATE 2
DRAG 31. LB/S-TON SPEED/LENGTH RATIO 0.504

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.206	34	3.85	4.11		4.45
	0.412	0.50	2.60	2.37		2.00
ACC A,G	0.007	59	0.10	0.16	0.23	0.44
	0.046	0.10	-0.08	-0.11	-0.14	-0.19
HEAVE, FT	-0.230	39	0.18	0.45		0.66
	0.318	0.15	-0.63	-0.87		-1.26
PITCH A, DEG	0.016	0	0.00	0.00	0.00	0.00
	0.051	1.20	0.00	0.00	0.00	0.00
ACC B,G	-0.002	13	0.08			0.16
	0.022	0.10	-0.06			-0.09
PITCH B, DEG	0.022	0	0.00	0.00	0.00	0.00
	0.040	1.20	0.00	0.00	0.00	0.00
ACC C,G	-0.001	8	0.07			0.11
	0.019	0.10	-0.06			-0.08
PITCH C, DEG	0.015	0	0.00	0.00	0.00	0.00
	0.048	1.20	0.00	0.00	0.00	0.00
ACC D,G	-0.002	12	0.06			0.08
	0.024	0.10	-0.07			-0.11

TABLE 16A.3

DAVIDSON LABORATORY 5-NOV-81

COUPLED AMPHIBIANS

RUN 158 FIXED TRIM, 2 DEGREES RELATIVE TRIM

SPEED 8.0 MPH WAVE ENCOUNTERS 68
WEIGHT 104.0 S-TONS SEA STATE 2
DRAG 53. LB/S-TON SPEED/LENGTH RATIO 0.672

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.272	28	3.86	4.11		4.32
	0.382	0.50	2.68	2.41		2.10
ACC A,G	0.008	56	0.12	0.19	0.27	0.59
	0.049	0.10	-0.07	-0.11	-0.14	-0.15
HEAVE, FT	-0.334	30	0.06	0.29		0.44
	0.290	0.15	-0.72	-0.94		-1.10
PITCH A, DEG	0.017	0	0.00	0.00	0.00	0.00
	0.051	1.20	0.00	0.00	0.00	0.00
ACC B,G	-0.002	16	0.07	0.08		0.10
	0.023	0.10	-0.07	-0.08		-0.13
PITCH B, DEG	0.022	0	0.00	0.00	0.00	0.00
	0.041	1.20	0.00	0.00	0.00	0.00
ACC C,G	-0.001	11	0.07			0.08
	0.020	0.10	-0.07			-0.13
PITCH C, DEG	0.015	0	0.00	0.00	0.00	0.00
	0.048	1.20	0.00	0.00	0.00	0.00
ACC D,G	-0.002	15	0.07	0.09		0.11
	0.023	0.10	-0.07	-0.09		-0.16

TABLE 16A.4

DAVIDSON LABORATORY 5-NOV-81

COUPLED AMPHIBIANS

RUN 159 FIXED TRIM, 2 DEGREES RELATIVE TRIM

SPEED 10.0 MPH
WEIGHT 104.0 S-TONS
DRAG 84. LB/S-TON

WAVE ENCOUNTERS 55
SEA STATE 2
SPEED/LENGTH RATIO 0.841

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH DEG	3.341	23	3.92	4.16		4.32
	0.360	0.50	2.75	2.53		2.37
ACC A,G	0.009	55	0.12	0.18	0.26	0.47
	0.050	0.10	-0.08	-0.12	-0.16	-0.21
HEAVE, FT	-0.471	25	-0.09	0.12		0.28
	0.300	0.15	-0.86	-1.05		-1.26
PITCH A, DEG	0.017	0	0.00	0.00	0.00	0.00
	0.050	1.20	0.00	0.00	0.00	0.00
ACC B,G	-0.002	25	0.07	0.10		0.20
	0.026	0.10	-0.07	-0.09		-0.12
PITCH B, DEG	0.022	0	0.00	0.00	0.00	0.00
	0.041	1.20	0.00	0.00	0.00	0.00
ACC C,G	-0.002	16	0.06	0.07		0.11
	0.022	0.10	-0.07	-0.09		-0.12
PITCH C, DEG	0.016	0	0.00	0.00	0.00	0.00
	0.047	1.20	0.00	0.00	0.00	0.00
ACC D,G	-0.002	23	0.07	0.09		0.12
	0.026	0.10	-0.08	-0.10		-0.15

TABLE 16B.1 (PHASE 2)

IRREGULAR WAVE STATISTICS

VEHICLE DISPLACEMENT 26 SHORT TONS

TRAIN OF FOUR VEHICLES, SPACING 1.425 FT

DAVIDSON LABORATORY HEAD SEAS 18-DEC-81

COUPLED AMPHIBIANS

RUN 225 FIXED TRIM, 2 DEGREES RELATIVE TRIM

SPEED 5.0 MPH WAVE ENCOUNTERS 91
WEIGHT 103.9 S-TONS SEA STATE 2
DRAG 22. LB/S-TON SPEED/LENGTH RATIO 0.420

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	2.306	44	2.86	3.12		3.54
	0.394	0.50	1.73	1.48		0.89
ACC A, G	0.003	56	0.09	0.13	0.17	0.24
	0.042	0.10	-0.08	-0.11	-0.13	-0.14
HEAVE, FT	-0.194	47	0.18	0.44	0.59	0.67
	0.287	0.15	-0.57	-0.79	-0.97	-1.13
ACC B, G	-0.000	24	0.07	0.08		0.10
	0.023	0.10	-0.06	-0.07		-0.09
ACC C, G	-0.000	8	0.06			0.07
	0.017	0.10	-0.06			-0.07
ACC D, G	0.001	30	0.07	0.08		0.10
	0.028	0.10	-0.06	-0.08		-0.11

TABLE 16B.2

DAVIDSON LABORATORY 18-DEC-81

COUPLED AMPHIBIANS

RUN 226

SPEED 10.0 MPH WAVE ENCOUNTERS 62
WEIGHT 103.9 S-TONS SEA STATE 2
DRAG 79. LB/S-TON SPEED/LENGTH RATIO 0.841

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	2.410	25	2.93	3.19		3.40
	0.332	0.50	1.90	1.71		1.53
ACC A, G	0.003	61	0.13	0.22	0.29	0.42
	0.052	0.10	-0.09	-0.13	-0.17	-0.24
HEAVE, FT	-0.408	26	-0.09	0.14		0.25
	0.263	0.15	-0.75	-0.95		-1.08
ACC B, G	-0.001	37	0.09	0.12		0.24
	0.031	0.10	-0.06	-0.09		-0.13
ACC C, G	0.001	18	0.06	0.07		0.08
	0.021	0.10	-0.07	-0.08		-0.11
ACC D, G	0.001	28	0.07	0.09		0.11
	0.027	0.10	-0.08	-0.10		-0.17

TABLE 16B.3

DAVIDSON LABORATORY 18-DEC-81

COUPLED AMPHIBIANS

RUN 227

SPEED 15.0 MPH WAVE ENCOUNTERS 46
WEIGHT 103.9 S-TONS SEA STATE 2
DRAG 206. LB/S-TON SPEED/LENGTH RATIO 1.260

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	3.041	20	3.46	3.66		3.74
	0.321	0.50	2.51	2.20		1.80
ACC A, G	0.002	47	0.11	0.16	0.21	0.27
	0.064	0.10	-0.11	-0.19	-0.24	-0.31
HEAVE, FT	-0.643	21	-0.41	-0.26		-0.10
	0.224	0.15	-0.84	-1.08		-1.20
ACC B, G	0.000	31	0.07	0.10		0.13
	0.034	0.10	-0.08	-0.11		-0.16
ACC C, G	0.002	21	0.07	0.09		0.12
	0.028	0.10	-0.07	-0.09		-0.10
ACC D, G	0.000	16	0.08	0.09		0.11
	0.028	0.10	-0.07	-0.09		-0.10

TABLE 16B.4

DAVIDSON LABORATORY 18-DEC-81

COUPLED AMPHIBIANS

RUN 228

SPEED 20.0 MPH WAVE ENCOUNTERS 46
WEIGHT 104.0 S-TONS SEA STATE 2
DRAG 419. LB/S-TON SPEED/LENGTH RATIO 1.682

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	5.628	22	6.15	6.46		6.58
	0.413	0.50	5.19	4.86		4.34
ACC A, G	-0.001	50	0.13	0.21	0.26	0.28
	0.085	0.10	-0.11	-0.18	-0.25	-0.31
HEAVE, FT	0.202	19	0.32	0.66		0.86
	0.324	0.15	0.00	-0.34		-0.51
ACC B, G	-0.001	25	0.08	0.11		0.14
	0.034	0.10	-0.07	-0.08		-0.09
ACC C, G	-0.001	18	0.07	0.10		0.12
	0.032	0.10	-0.08	-0.10		-0.15
ACC D, G	0.004	14	0.07	0.10		0.17
	0.033	0.10	-0.09	-0.11		-0.14

TABLE 16B.5

DAVIDSON LABORATORY 18-DEC-81

COUPLED AMPHIBIANS

RUN 229

SPEED 24.9 MPH WAVE ENCOUNTERS 43
WEIGHT 104.0 S-TONS SEA STATE 2
DRAG 604. LB/S-TON SPEED/LENGTH RATIO 2.089

	MEAN/RMS	OSC/BUFF	AVG	1/3	1/10	EXTREME
PITCH, DEG	6.556	21	7.06	7.49		7.72
	0.434	0.50	5.97	5.64		5.41
ACC A, G	-0.002	62	0.15	0.27	0.35	0.48
	0.122	0.10	-0.13	-0.23	-0.31	-0.42
HEAVE, FT	1.843	18	1.99	2.53		2.72
	0.585	0.15	1.73	1.14		0.68
ACC B, G	-0.001	43	0.09	0.13		0.18
	0.051	0.10	-0.08	-0.11		-0.20
ACC C, G	0.000	19	0.08	0.11		0.17
	0.042	0.10	-0.09	-0.13		-0.19
ACC D, G	-0.003	24	0.08	0.13		0.17
	0.036	0.10	-0.09	-0.11		-0.12

TABLE 17

VIDEO SCENARIO

RUN	FOOTAGE	RUN	FOOTAGE	RUN	FOOTAGE
Title	0	38	140	69	238
5	3	40	144	70	242
Trial	11	41	148	71	245
7	15	42	150	73	248
8	25	44	155	74	255
9	30	45	159	75	259
14	35	46	162	76	264
15	50	47	165	77	267
16	58	48	168	79	271
17	64	50	174	80	277
19	68	51	180	81	282
20	74	52	184	82	286
21	81	53	187	83	288
22	86	54	190	86	294
23	90	55	194	87	300
24	93	57	198	88	304
27	98	58	201	89	307
28	106	59	205	92	310
29	111	60	209	93	314
30	115	62	214	94	317
31	119	63	222	95	319
32	123	64	226	98	323
35	125	65	229	99	328
36	130	66	232	100	332
37	135	67	235	102	336

TABLE 17

(Continued)

RUN	FOOTAGE	RUN	FOOTAGE	RUN	FOOTAGE
103	339	154	462	213	572
104	341	156	468	214	573
108	345	157	477	216	575
109	350	158	484	217	577
110	354	159	489	218	578
111	358	161	496	219	579
112	359	162	505	220	580
113	360	163	510	222	581
128	363	164	516	225	582
129	369	165	524	226	588
130	374	166	530	227	591
131	377	167	534	228	594
132	379	168	538	229	596
133	382	169	541	231	597
134	384	170	548	232	603
135	387	171	553	233	605
136	389	172	557	234	607
137	391	203	561	235	608
143	395	204	563	236	609
144	419	205	564	237	614
145	430	206	565	238	617
147	435	207	566	239	619
148	442	210	568	240	620
149*	447	211	570	241	621
153	457	212	571		

Note: *Also Run 148 on Video

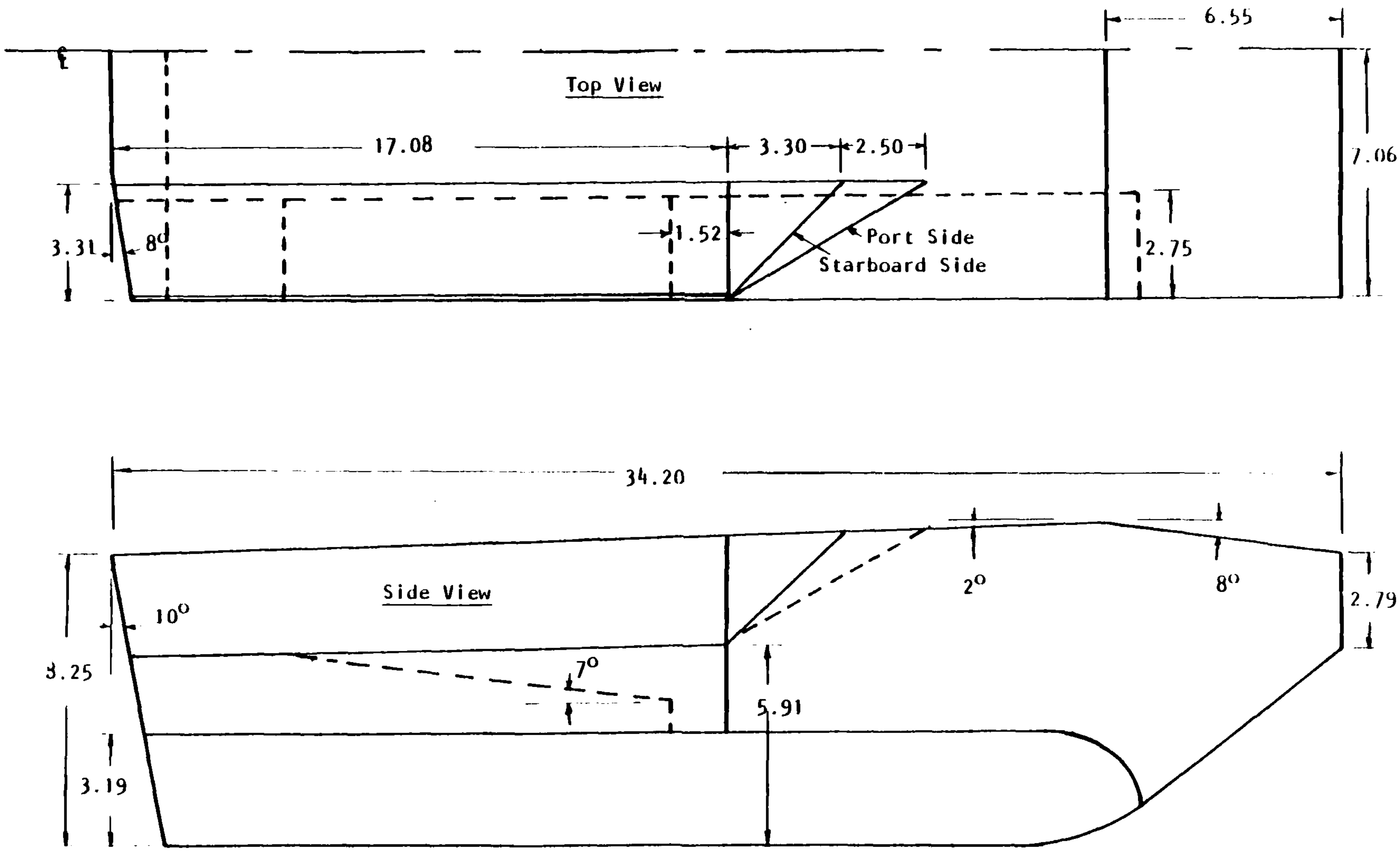


FIGURE 1A PRINCIPAL DIMENSIONS OF LVT MODEL (INCHES)

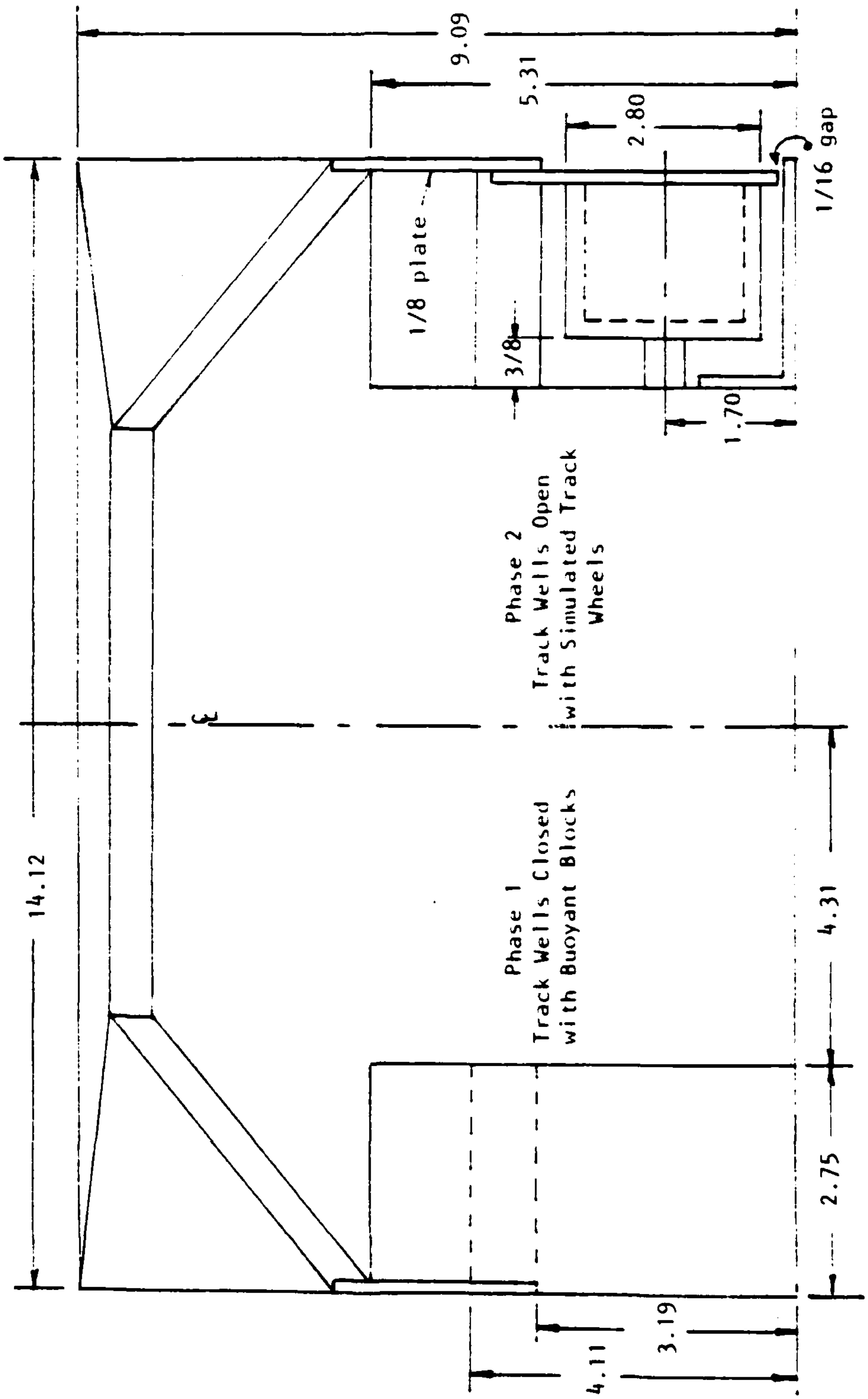


FIGURE 1B STERN VIEW OF LVT MODEL (INCHES)

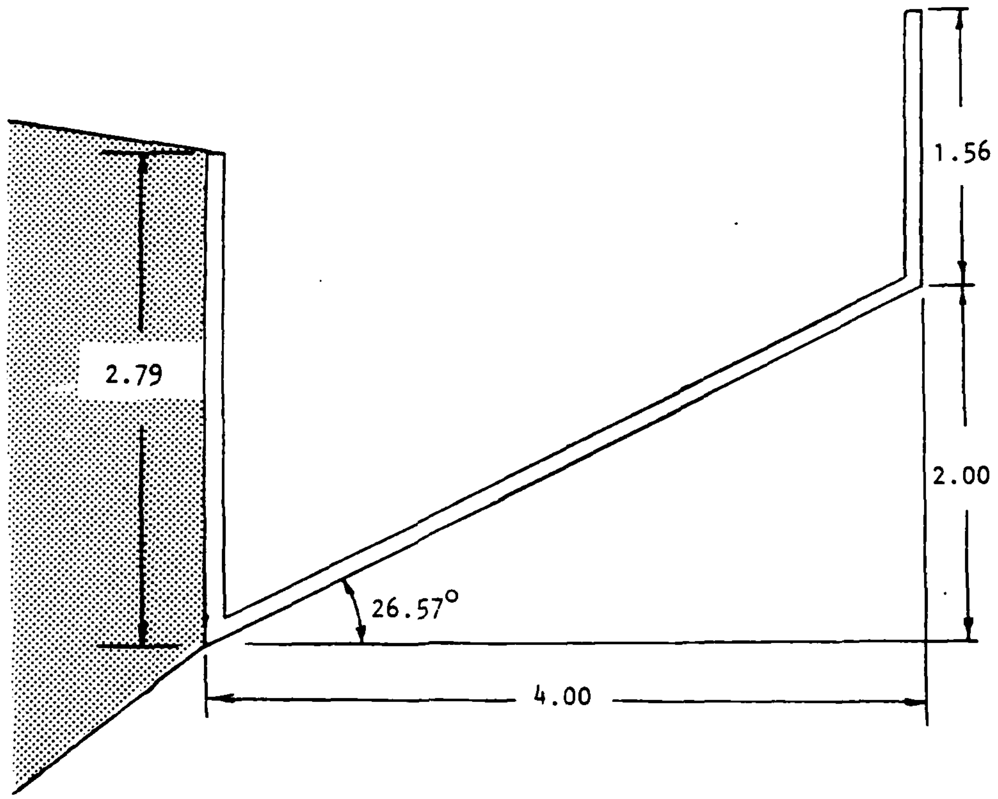
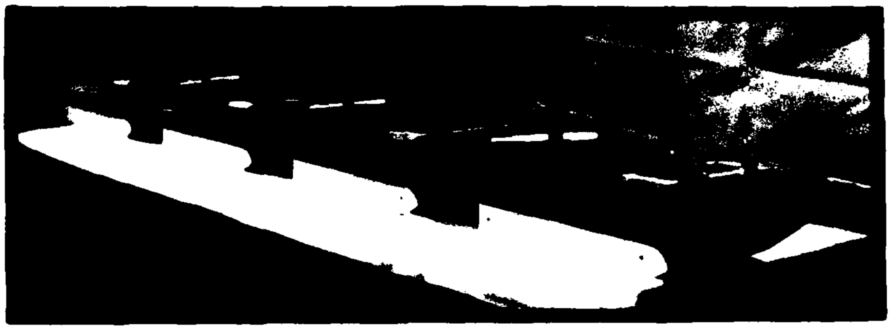
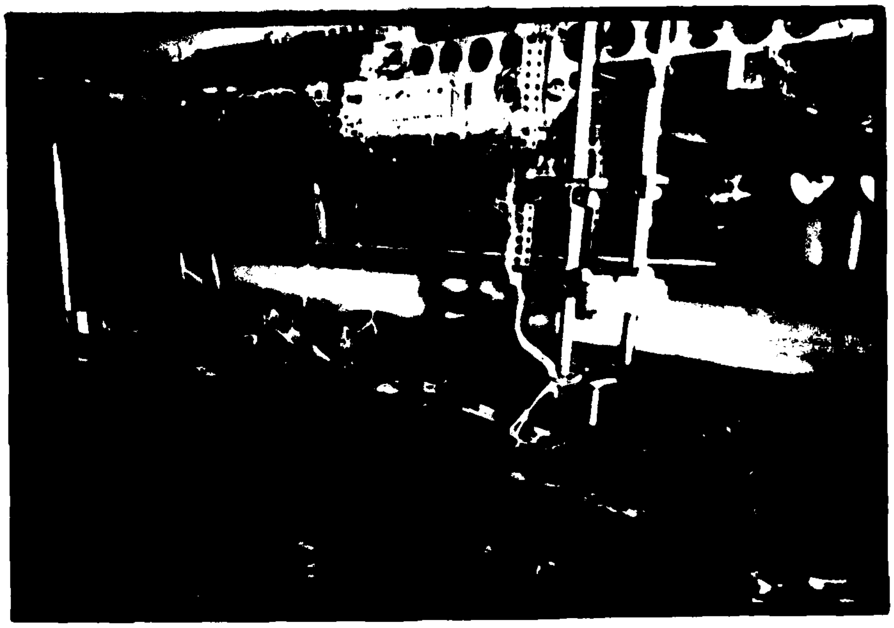


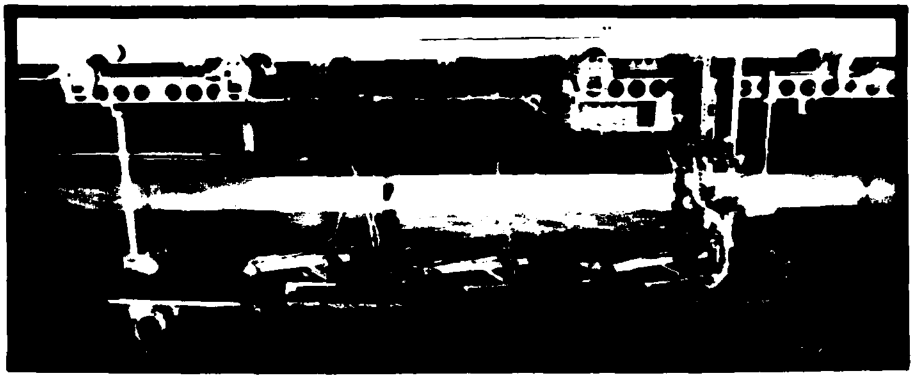
FIGURE 2 LVT MODEL BOW FLAP (Inches)



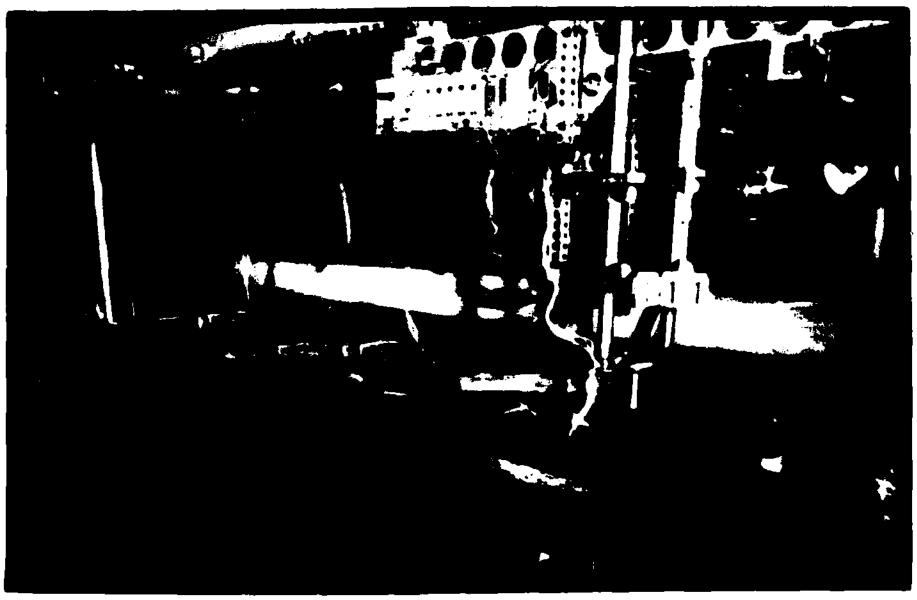


SPEED 4 MPH, SEA STATE 2, SPACING 1.425 FT.

FIGURE 3 LVT MODELS SET-UP IN THE FREE-TO-TRIM MODE

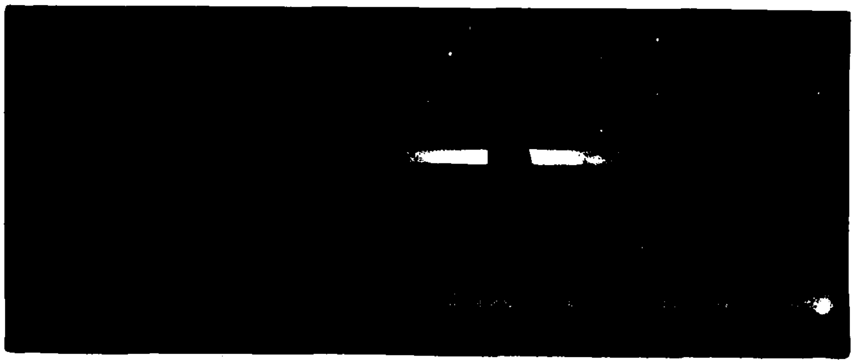


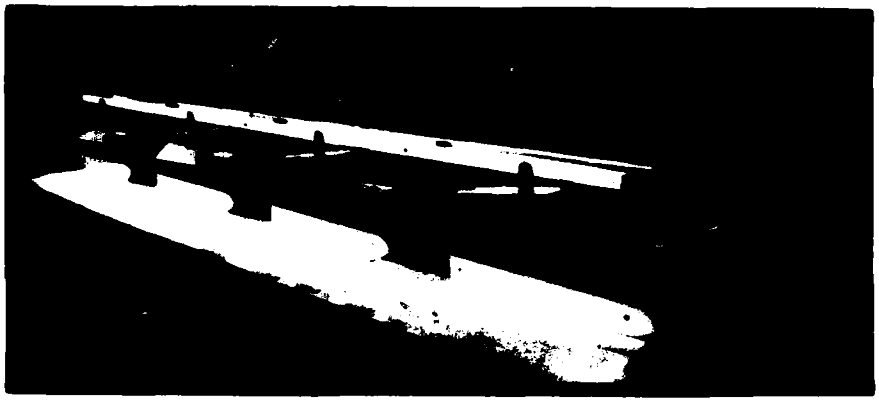
ZERO SPEED

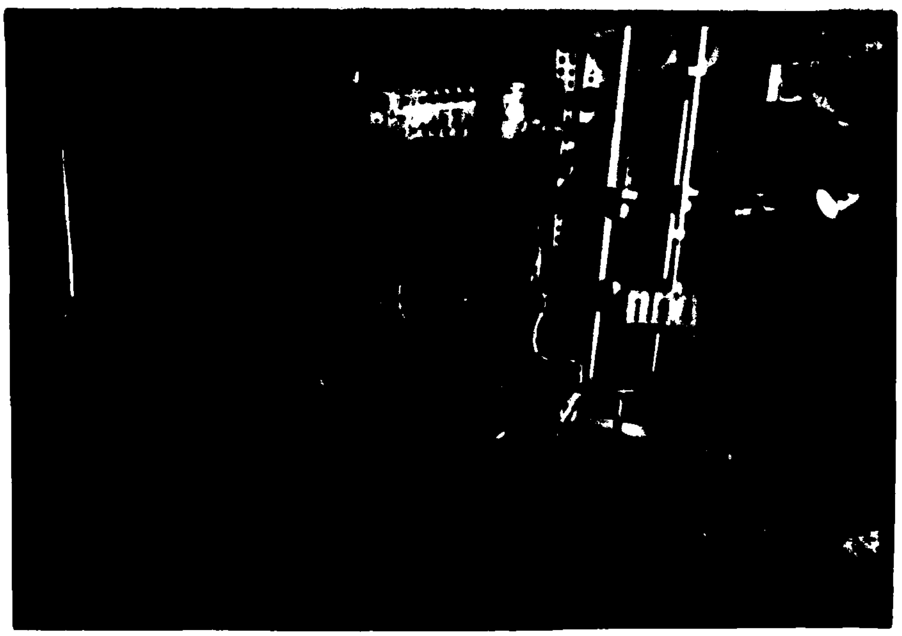


SPEED 10 MPH, CALM WATER, 2 DEGREES RELATIVE TRIM
SPACING 1.425 FT.

FIGURE 4 LVT MODELS SET-UP IN THE FIXED RELATIVE TRIM MODE

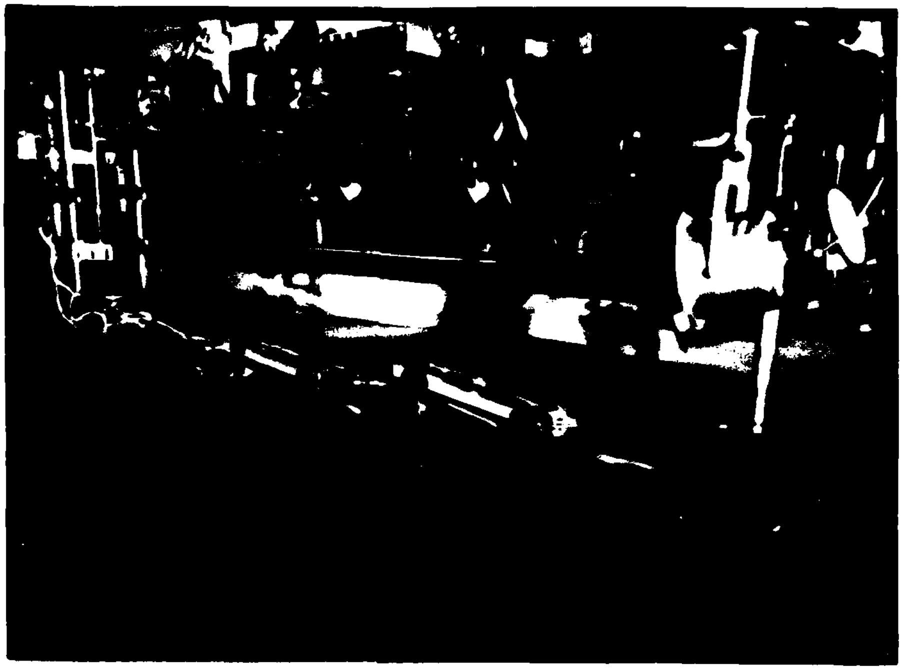






SPEED 12 MPH, CALM WATER, 6 DEGREES ABSOLUTE TRIM
SPACING 2.85 FT.

FIGURE 5 LVT MODELS SET-UP IN THE FIXED PARALLEL TRIM MODE



SEA STATE 2, FOLLOWING SEAS, 2 DEGREES FIXED RELATIVE TRIM

CALM WATER, 2-TWO TRAIN UNITS
14.9 FT. SPACING BETWEEN VEHICLES 2 AND 3

FIGURE 6 LVT'S OPERATING AT 12 MPH, SPACING 1.425 FT.

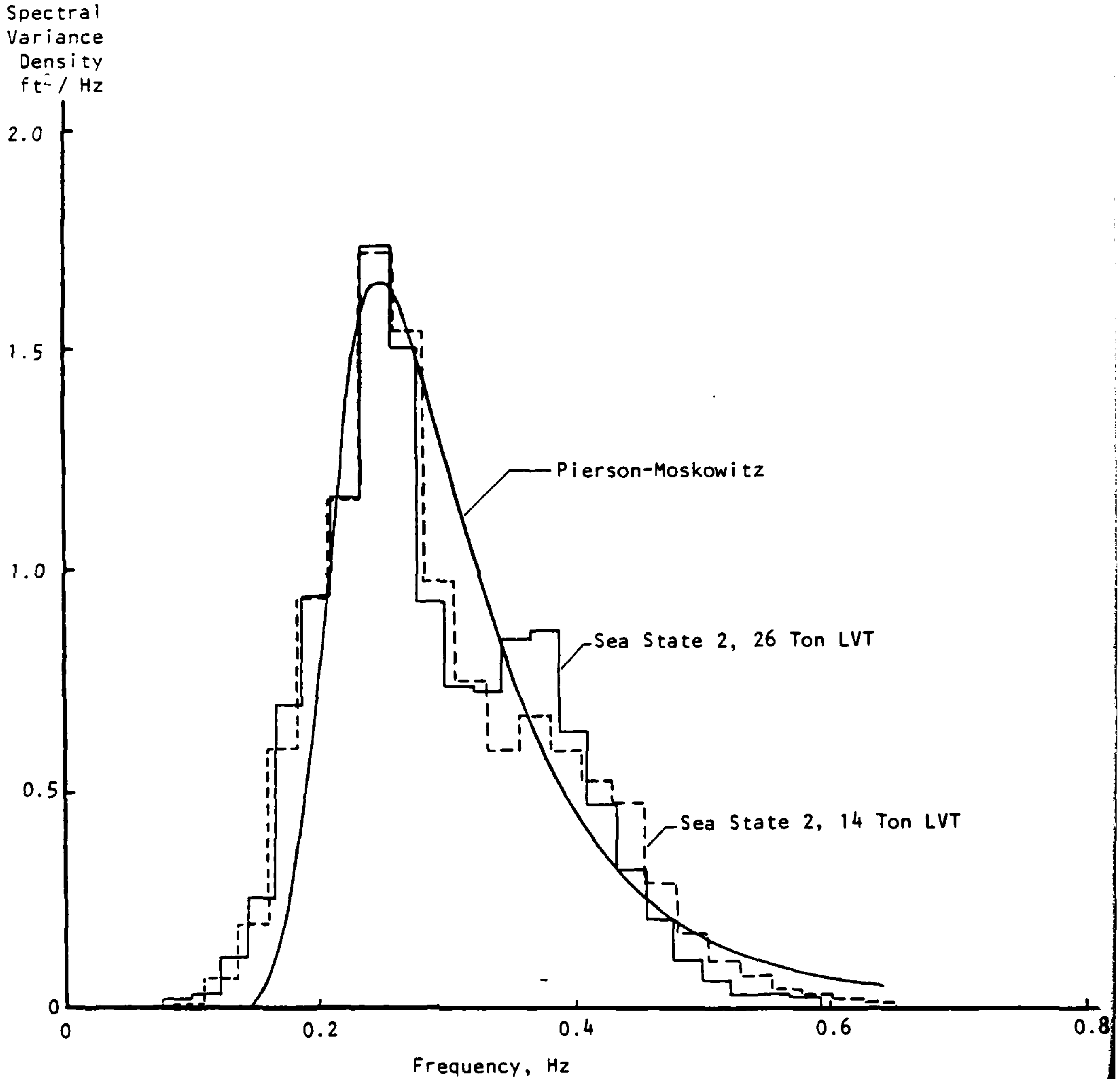


FIGURE 7 EXPERIMENTAL WAVE SPECTRA, 2.2 ft SIGNIFICANT WAVE HEIGHT

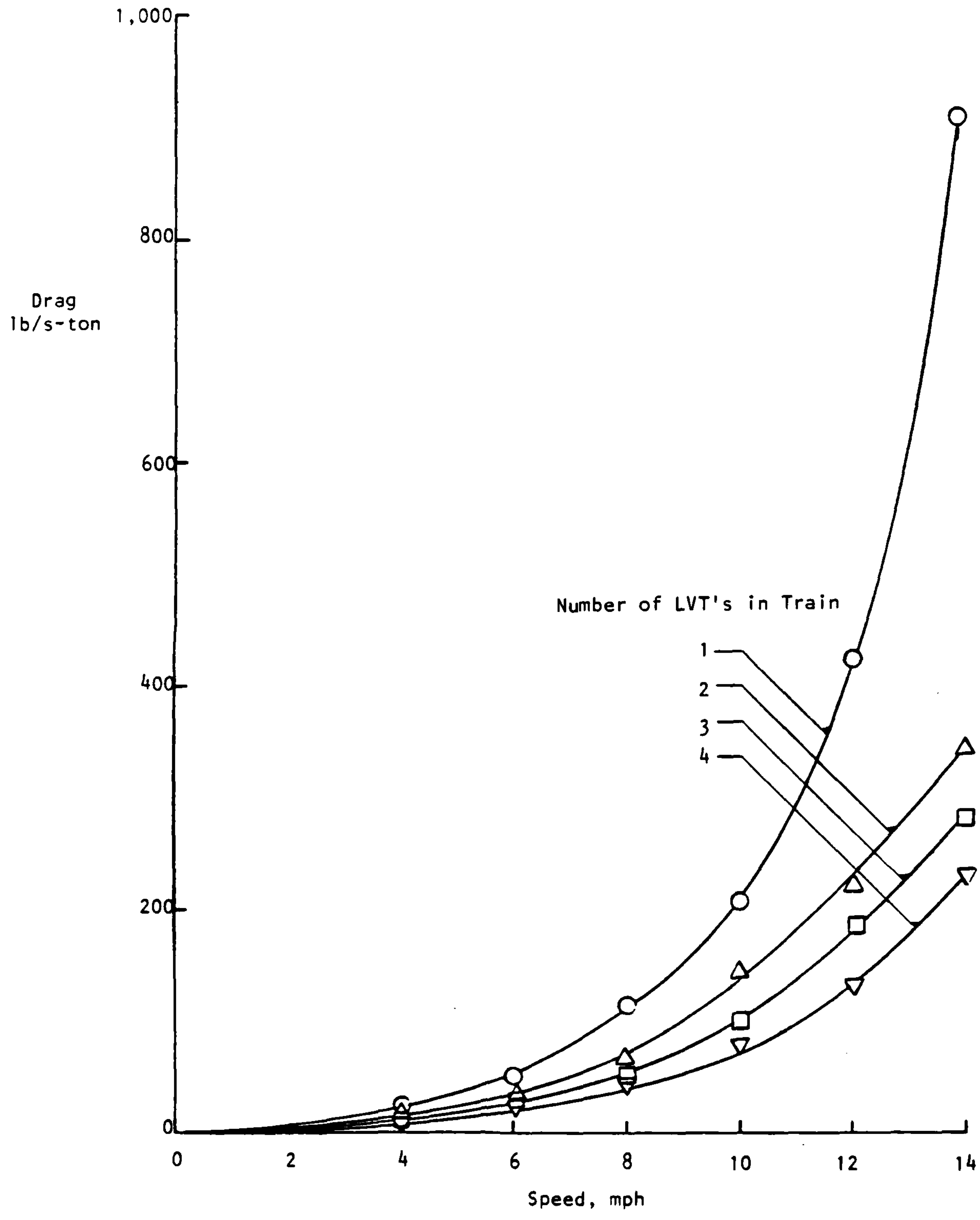


FIGURE 8 CALM WATER DRAG PERFORMANCE; FREE-TO-TRIM
5.6% SPACING

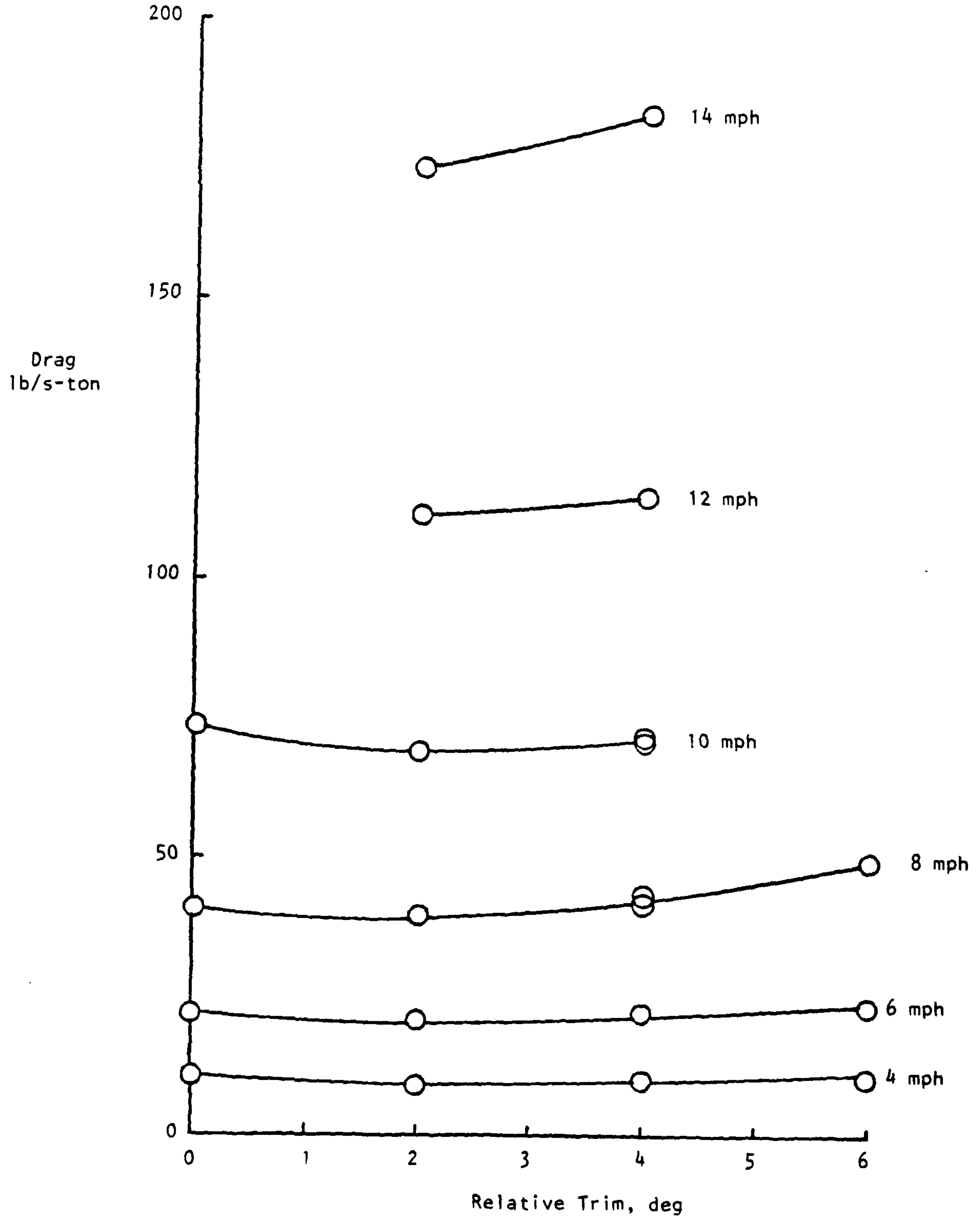


FIGURE 9 CALM WATER DRAG PERFORMANCE SHOWING EFFECT OF FIXED RELATIVE TRIM
4 LVT's, 11.1% SPACING

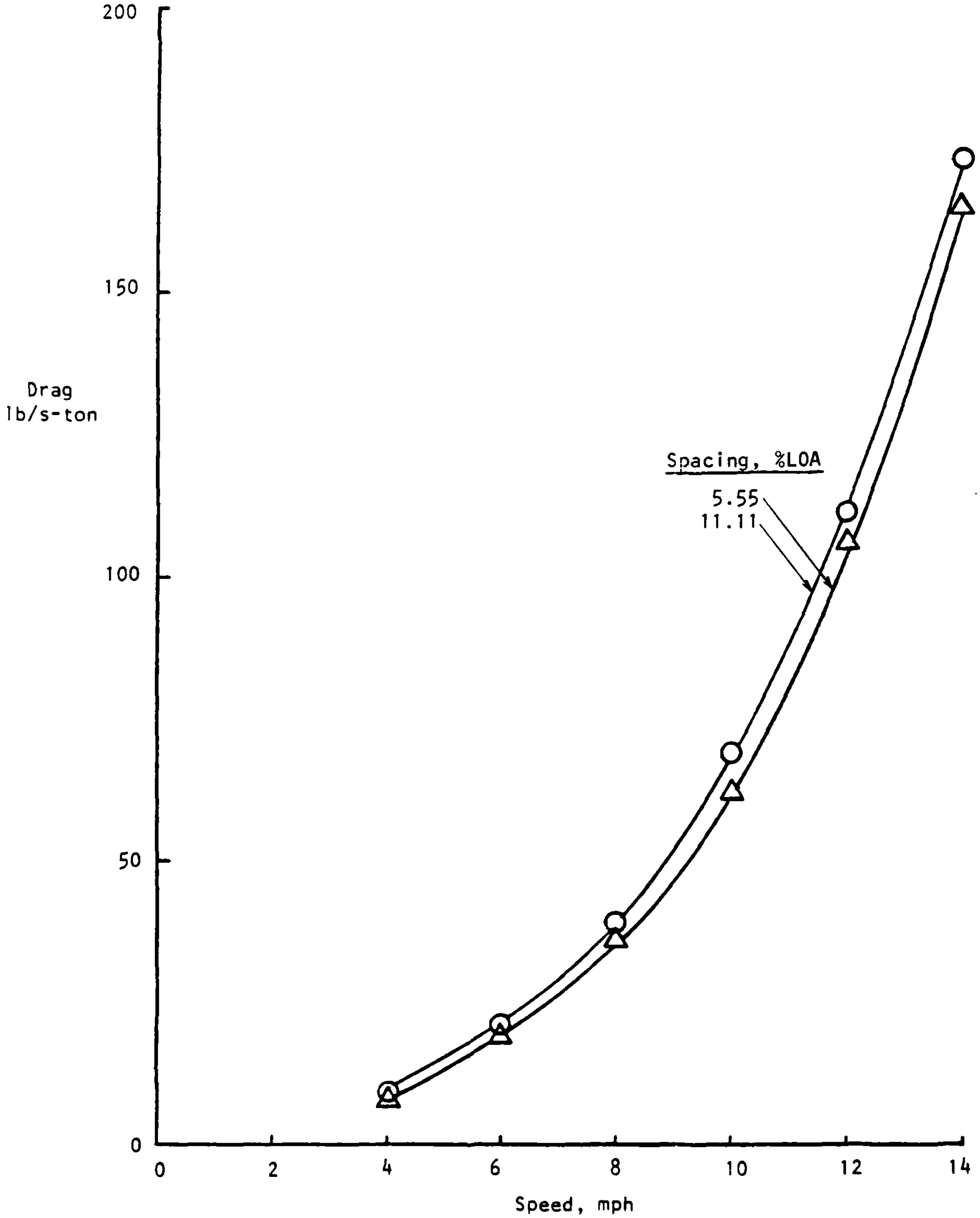
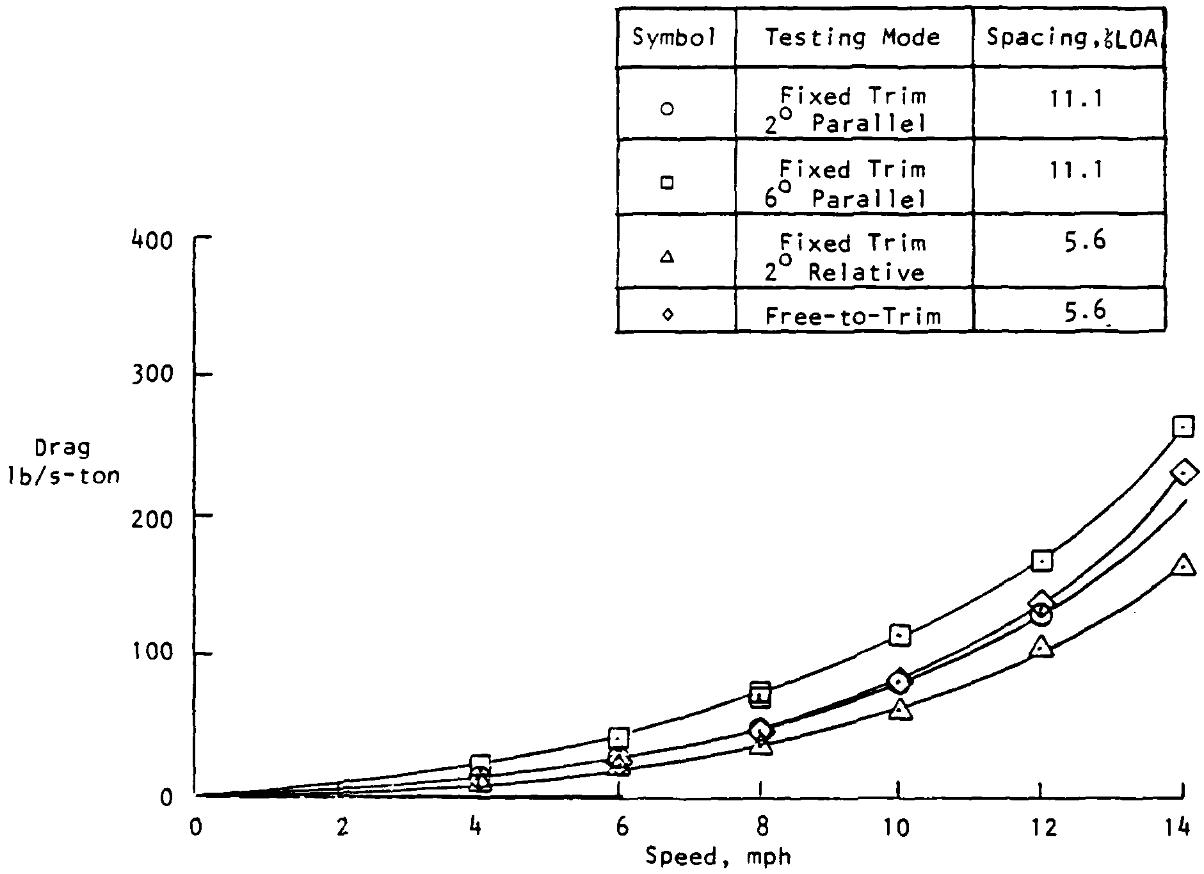


FIGURE 10 CALM WATER DRAG PERFORMANCE SHOWING EFFECT OF SPACING
4 LVT'S, FIXED 2 DEGREES RELATIVE TRIM



Symbol	Testing Mode	Spacing,%LOA
○	Fixed Trim 2° Parallel	11.1
□	Fixed Trim 6° Parallel	11.1
△	Fixed Trim 2° Relative	5.6
◇	Free-to-Trim	5.6

FIGURE 11 CALM WATER DRAG PERFORMANCE FOR A 4 VEHICLE TRAIN-
EFFECT OF COUPLING CONFIGURATION

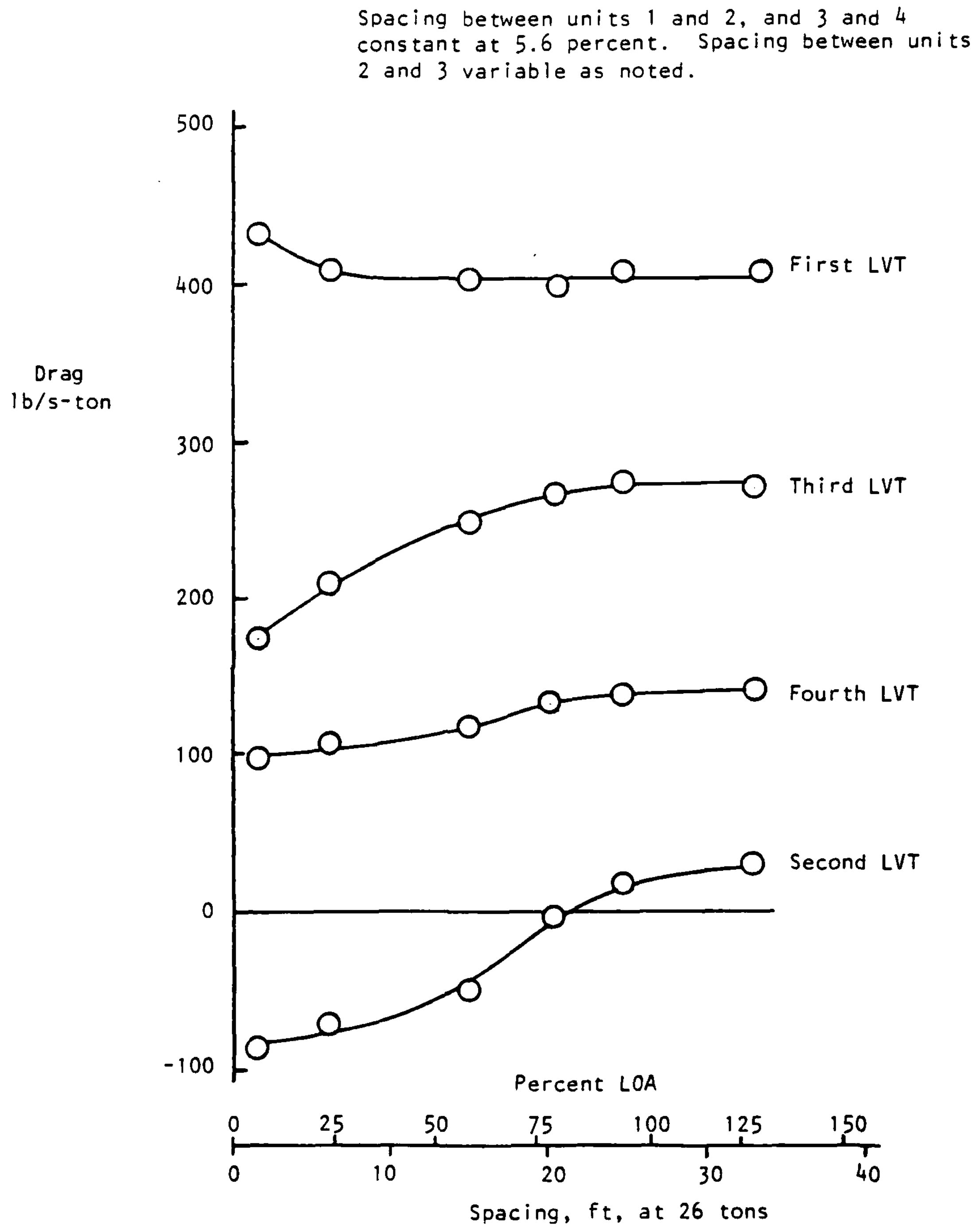


FIGURE 12 CALM WATER DRAG OF INDIVIDUAL LVT'S AT 12 MPH. LVT'S CONNECTED AS 2-TWO UNIT TRAINS, FREE-TO-TRIM

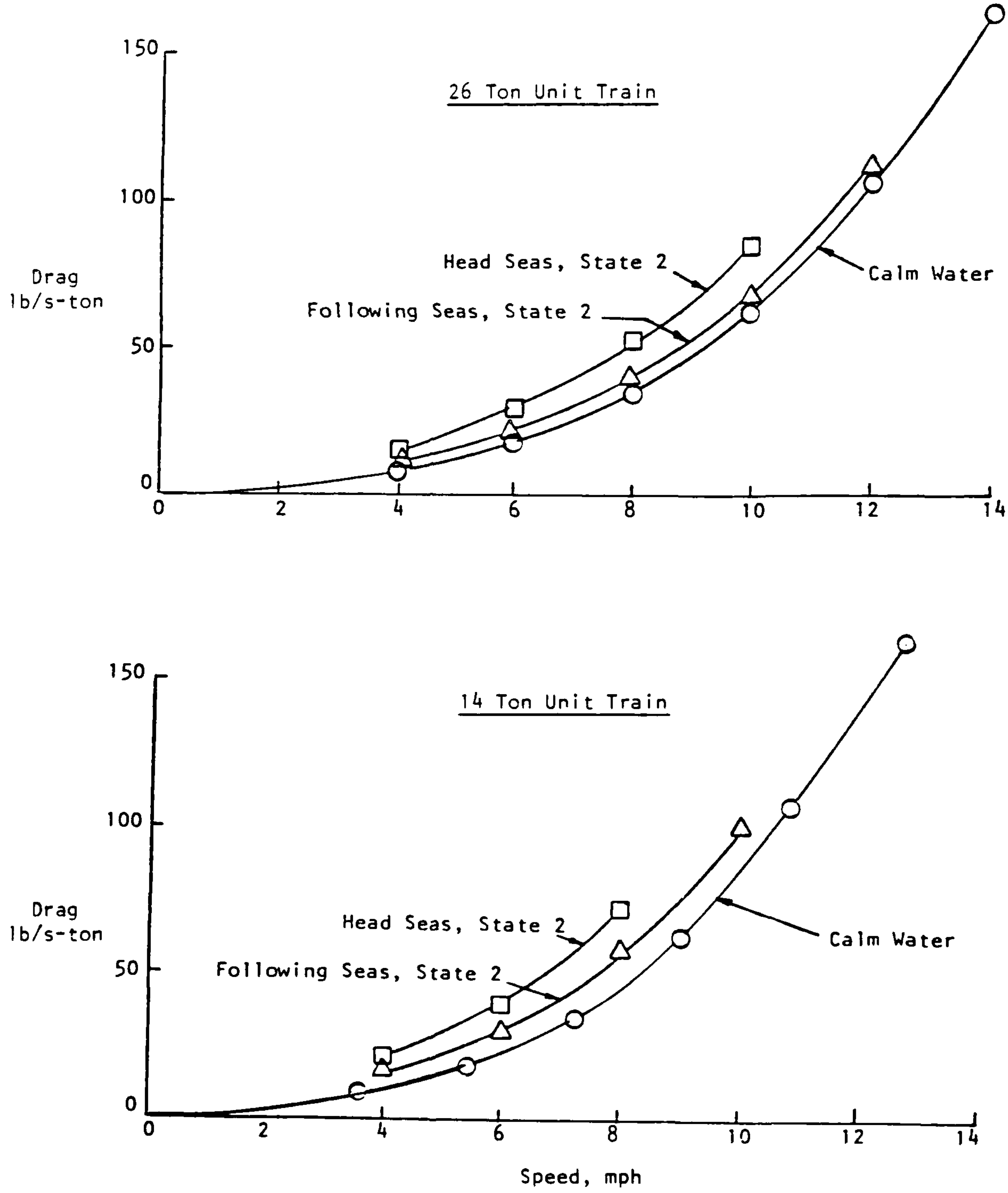


FIGURE 13 DRAG OF 4 VEHICLE TRAIN IN IRREGULAR WAVES
4 UNITS FIXED AT 2 DEGREES RELATIVE TRIM, 5.55% LOA SPACING

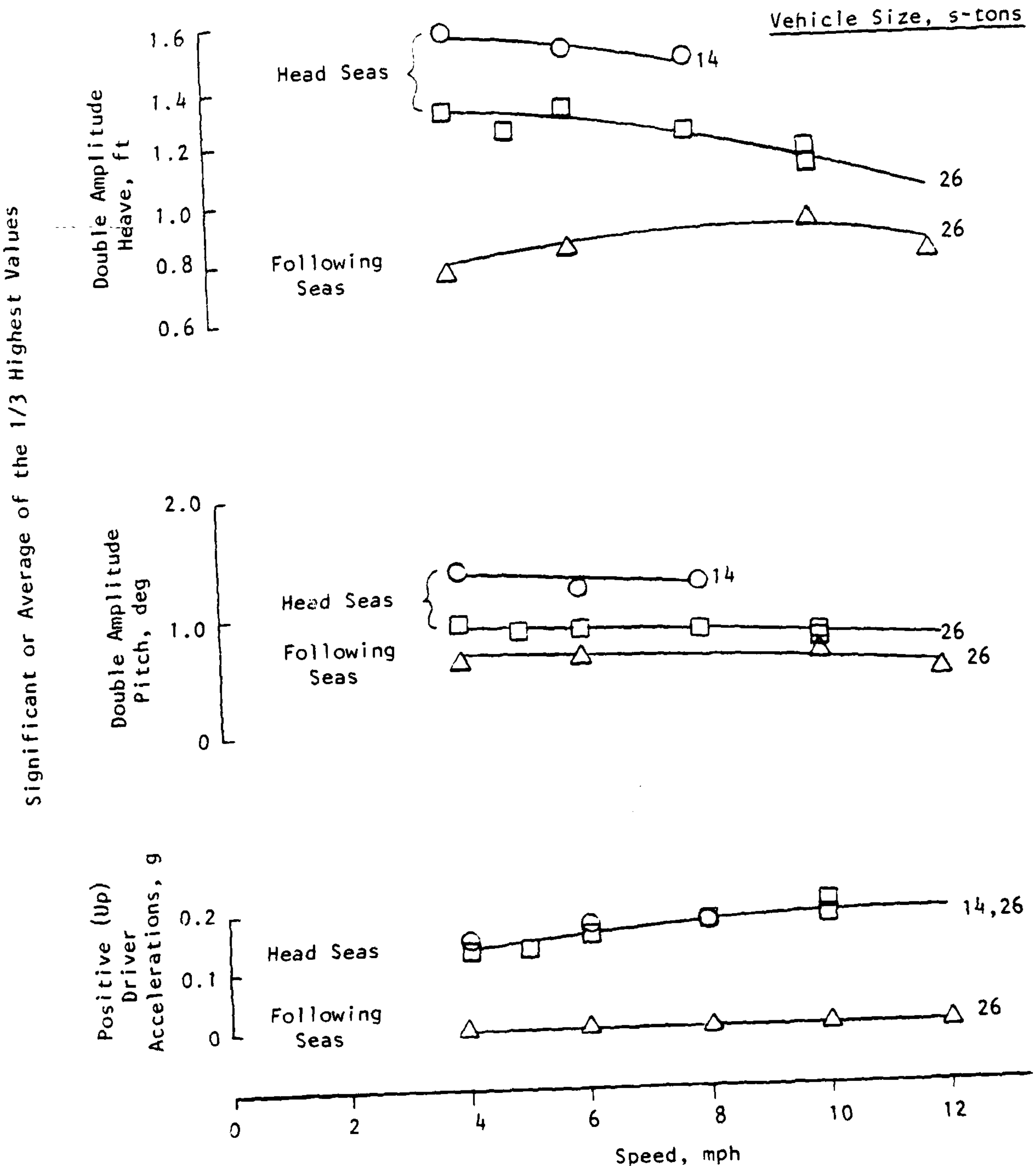


FIGURE 14 EFFECT OF SIZE AND WAVE DIRECTION ON THE MOTIONS AND ACCELERATIONS IN SEA STATE 2

4 LVT'S IN TRAIN FIXED AT 2 DEGREES RELATIVE TRIM

5.55% LOA SPACING

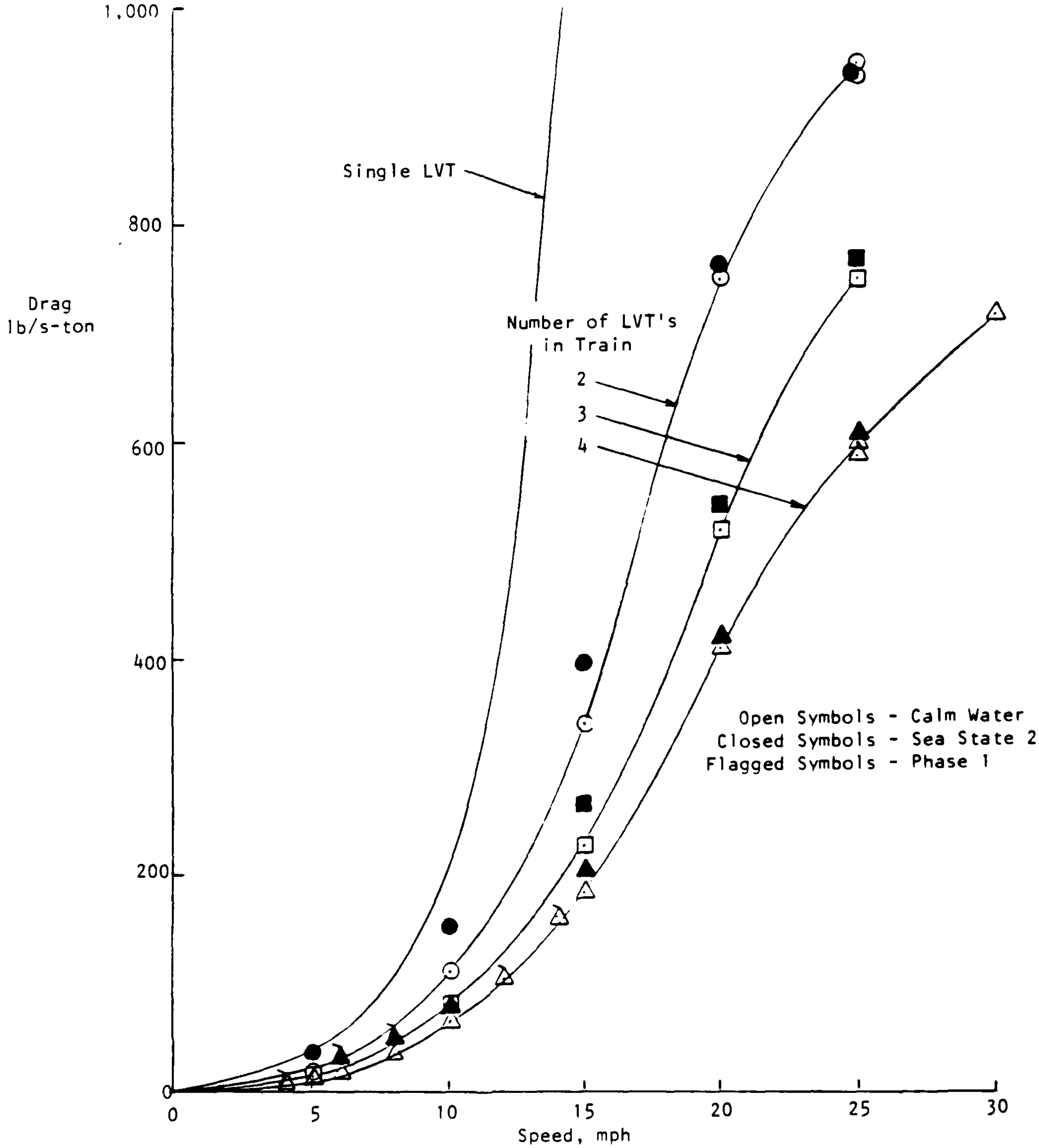


FIGURE 15 DRAG PERFORMANCE IN CALM WATER AND WAVES. VEHICLES FIXED AT 2 DEGREES RELATIVE TRIM, 1.425 FT SPACING FOR 26 SHORT TON DISPLACEMENT

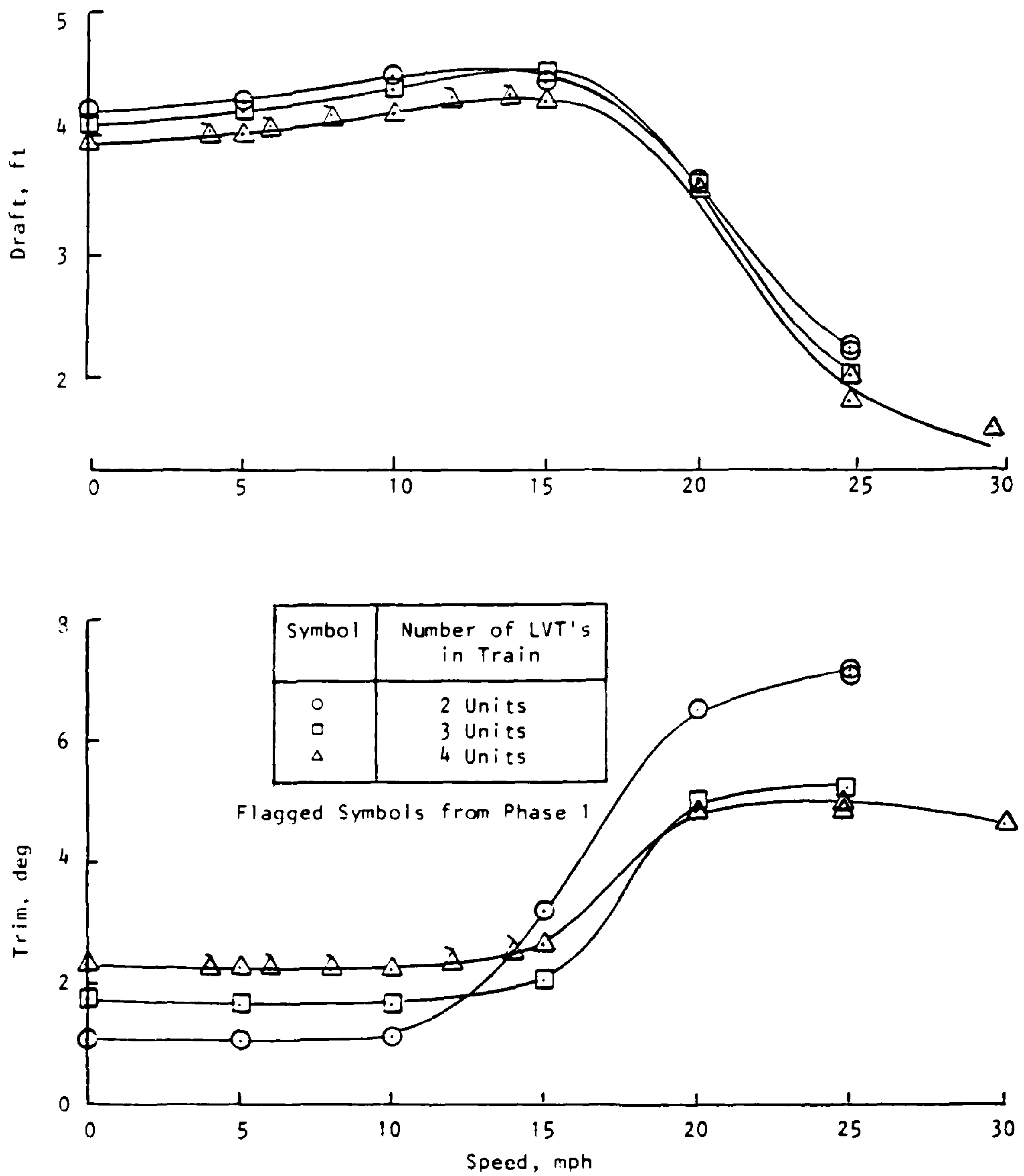
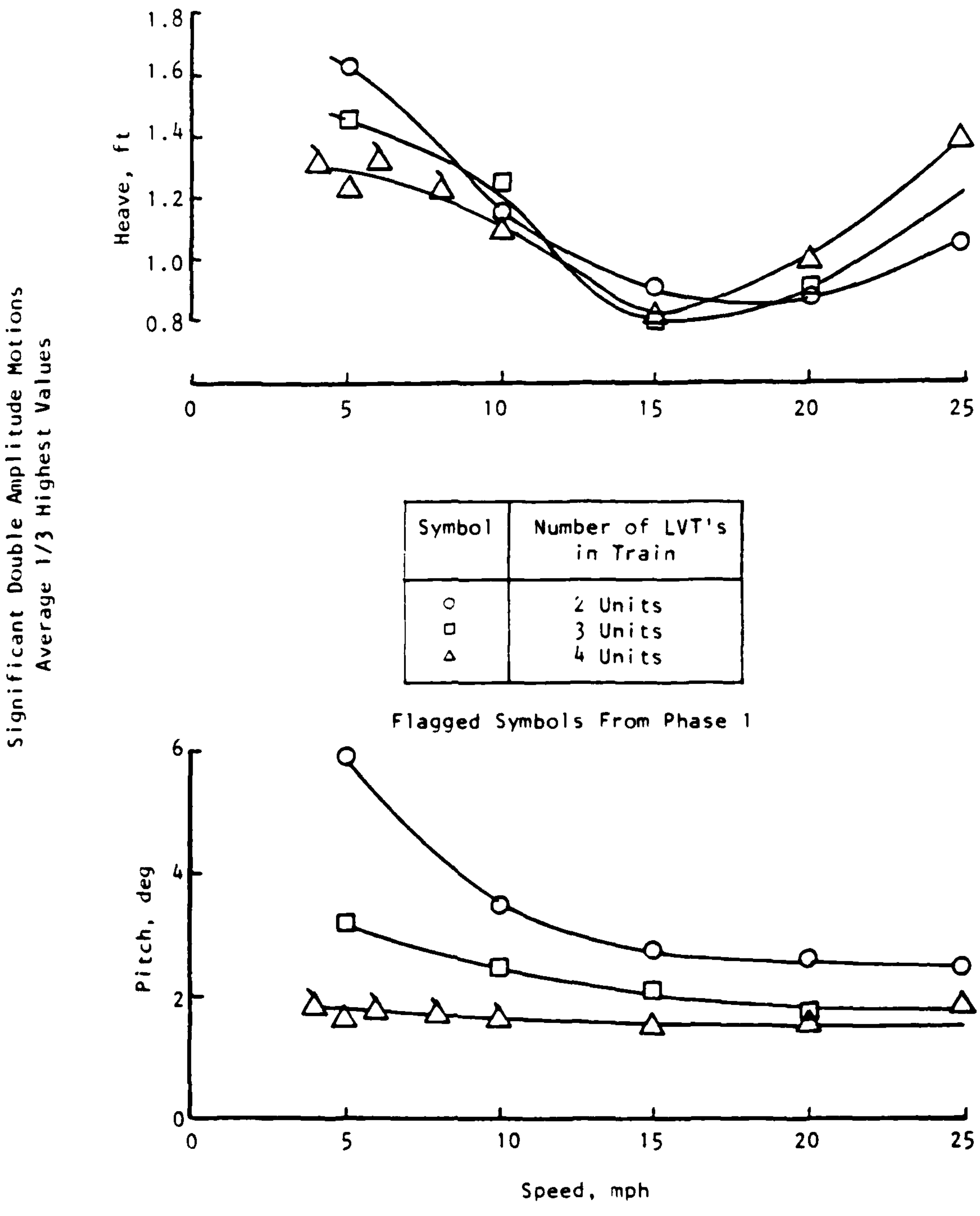


FIGURE 16 CALM WATER TRIM AND DRAFT PERFORMANCE

FIXED TRIM, 2 DEGREES RELATIVE TRIM, 1.425 FT SPACING



Symbol	Number of LVT's in Train
○	2 Units
□	3 Units
△	4 Units

Flagged Symbols From Phase 1

FIGURE 17 SIGNIFICANT MOTIONS IN SEA STATE 2, HEAD SEAS, 26 TON DISPLACEMENT, 1.425 FT SPACING LVT's FIXED AT 2 DEGREES RELATIVE TRIM

Symbol	Number of LVT's in Train
○	2 Units
□	3 Units
△	4 Units

Flagged Symbols from Phase 1

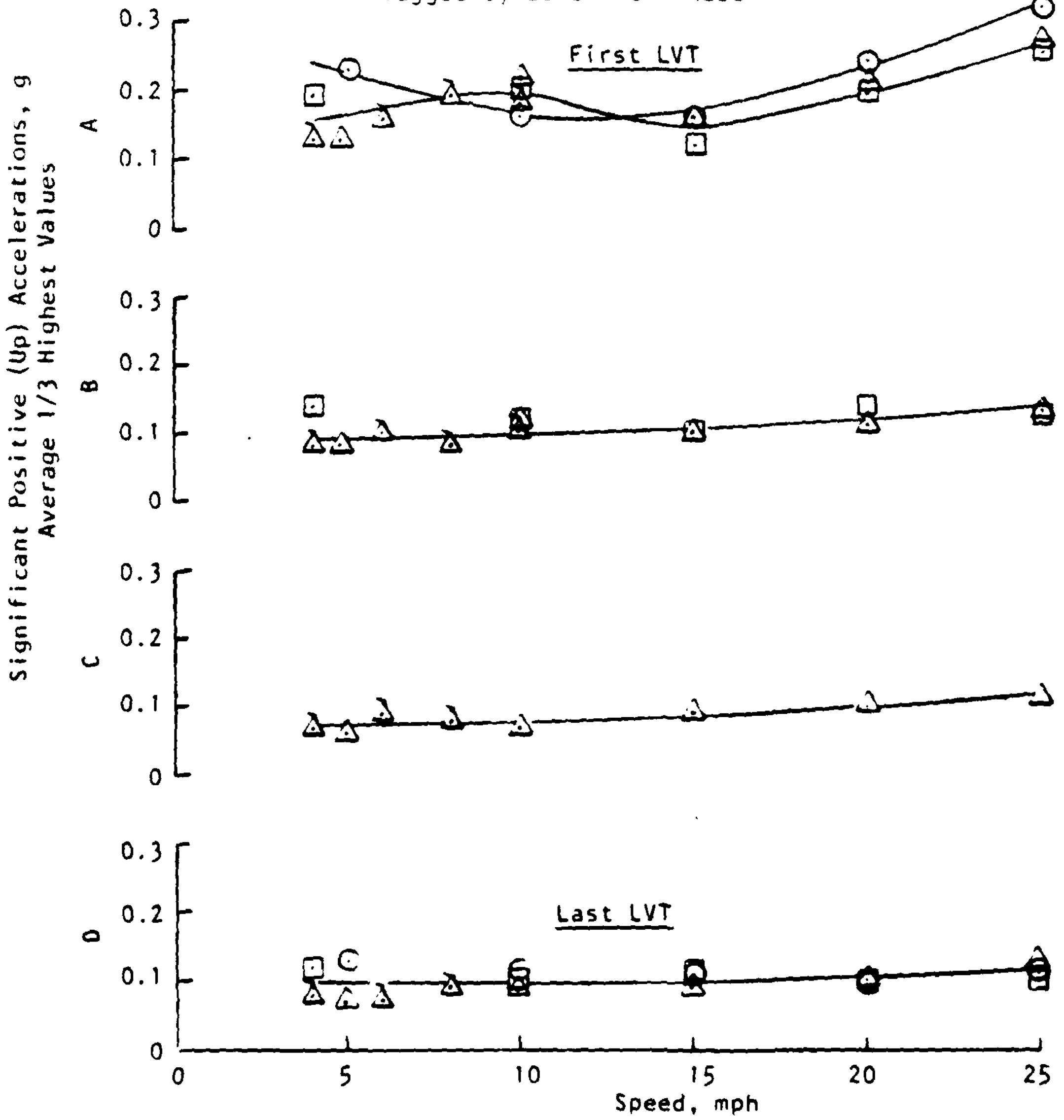


FIGURE 18 SIGNIFICANT DRIVER ACCELERATIONS IN SEA STATE 2, HEAD SEAS, 26 TON DISPLACEMENT, 1.425 FT SPACING LVT'S FIXED AT 2 DEGREES RELATIVE TRIM

DATE
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– 8